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Economics of Education: A Review

M. Woodhall

The economics of education is a branch of economic theory and investigation which has developed rapidly since the 1960s but has a much longer history. Several of the classical economists writing in the eighteenth and nineteenth century, including Adam Smith, Alfred Marshall, and John Stuart Mill, drew attention to the importance of education as a form of national investment and considered the question of how education should be financed. In the Soviet Union the Russian economist Strumilin examined "the economic significance of national education" in 1924. However, it was a revival of interest in the concept of investment in human capital which developed in the United States and the United Kingdom in the late 1950s and early 1960s that stimulated new interest in the question of the relationships between education and the economy. Since that time there has been a tremendous growth of research and publications in the area of the economics of education, including such topics as the contribution of education to economic growth, the profitability of investment in education (including estimates of the social and private returns to education), the role of educated manpower in economic development (including attempts to forecast manpower requirements), the costs of education (including questions of cost effectiveness and productivity), the finance of education, and more recently studies of the effects of education on the distribution of income and wealth.

More detailed information on all these topics is given in other articles (see *Human Capital Concepts; Cost Analysis in Education; Public Finance in Education; Forecasting Manpower Requirements; Income Distribution and Education*). This overview provides a brief summary of the main areas of research in the economics of education and shows how this relates to other branches of economic theory.

1. Human Capital

The concept of human capital is central to much of the research in the economics of education, and is also important in other branches of economics which at times overlap with the economics of education, particularly analysis of the labour market and employment policy, the determinants of earnings, and the distribution of income. An important distinction in economics is between investment and consumption. All expenditure can be classified as either investment or consumption, although the borderline is not always clear cut. Consumption refers to the purchase or use of goods and services which bring immediate but short-lived benefits. Investment, on the other hand, refers to the acquisition of assets which yield benefits over a long period of time. Expenditure on food, for example, must obviously be classified as consumption, whereas expenditure on buildings or equipment which will provide benefits over many years is a form of investment, and the stock of assets which will yield benefits in the future is called capital.

Economic theories of capital and investment tended to concentrate on investment in physical capital, such as buildings, factories, and machines which generate income in the form of production of goods and services. However, many economists have pointed out that education and training create assets in the form of knowledge and skills which increase the productive capacity of manpower in just the same way as investment in new machinery raises the productive capacity of the stock of physical capital. Adam Smith pointed out in 1776 in *The Wealth of Nations* that "a man educated at the expense of much labour and time. . . may be compared to one of those expensive machines", and other classical economists observed that expenditure on education could be regarded as a form of investment that promised future benefits. In the early years of the twentieth century the Russian economist Strumilin (1924) and economists in the United Kingdom and Europe drew analogies between investment in education and investment in physical capital. However, it was in the period 1955 to the present day when there was such a growth of interest in the idea that expenditure on education represented investment in human capital that one writer, reviewing the theoretical and empirical work on the subject, has described it as "the human investment revolution in economic thought" (Bowman 1966). Economists such as Schultz (1961, 1971) and Becker (1975) have developed and analysed the concept of human capital, treating education and training as a form of investment, producing future benefits in the form of higher income for both educated individuals and for society as a whole.

The concept of human capital can be applied not only to education and training, but to any activity which increases the quality and productivity of the labour force and thus raises future income levels. Thus expenditures on health and migration can also be regarded as investment in human capital and the question is then raised of how profitable it is for individuals or for society to invest resources in education or training, rather than in physical capital or in other forms of human capital.

Techniques of cost–benefit analysis have therefore been applied to education, in order to compare the total costs of education, either to the individual or to society, with the expected returns from investment in schooling or on-the-job training. This provides a measure of the private or social rate of return to investment in education, which shows the relative profitability of education and other forms of investment for the individual (in the case of the private rate of return) or for society as a whole.

The costs of education are measured in terms of the total resources devoted to education, which economists call the opportunity cost, rather than simply the money spent on education by governments or by individuals. The opportunity cost includes the value of all the goods and services used in the education process, not only the time of teachers and other staff, the use of books, equipment, furniture, heat, light, materials, and school or college buildings, but also the time of students and pupils, which does not form part of the money costs of education, but is part of the real resource cost. The usual way of measuring the economic value of student or pupil time is in terms of earnings forgone, which represent the opportunity cost of their time. The loss of the opportunity to earn wages or salaries in the labour market is the true cost, to the individual student, of his or her decision to enrol in a full-time or part-time course of education. For the economy as a whole, the loss of the output that the student could have produced, if in employment, is part of the resource costs of education.

The benefits of education are measured in terms of the extra lifetime incomes or earnings enjoyed by educated manpower, compared with workers with lower levels of education, or illiterate workers (see *Earnings and Education*).

Analysis of the costs and benefits of education show that not only do educated workers receive higher wages and salaries than the less educated in a huge number of cases, but when compared with the direct and indirect costs of education, these benefits mean that education is a profitable form of investment offering returns as igh or even higher than the average rate of return to physical capital. A review of cost–benefit analysis of ducation in 32 countries (Psacharopoulos 1973) showed that not only is education profitable but that in many cases, particularly in developing countries, the rate of eturn to education exceeds the rate of return to physical capital, the private rate of return is consistently higher an the social rate of return, and the rate of return to primary education is generally higher than the rate of turn to secondary or higher education.

This means that, from a purely economic point of view, it is more profitable to invest additional resources the lower levels of education than to expand higher education, although the social and private demand for higher education has expanded rapidly in recent years, particularly in less developed countries. Thus, the concept of human capital, and in particular the concept of the rate of return to investment in education, is relevant to the question of how society's resources should be allocated between different types of investment. Comparisons between the rate of return to human capital and the returns to investment in physical capital are relevant to the question of how many resources should be devoted to education or to other forms of investment in human capital such as vocational and industrial training or health care. Comparisons between the rate of return to different levels or types of education can be used as a guide to resource allocation within the educational system.

Since education is not a purely economic activity, but has many other objectives, concepts such as human capital and cost–benefit analysis can never provide a complete answer to the question of how resources should be allocated. However, the analysis of the returns to investment in education can throw some light on the question of how to allocate resources most efficiently or profitably, in other words how to maximize the returns or benefits derived from those resources. A great deal of economic theory is concerned with the vital issue of resource allocation, since society's resources are scarce and therefore choices must be made between alternative ways of allocating resources between competing ends.

2. *Economic Efficiency*

The question of how resources should be allocated in order to produce different goods and services raises the question of economic efficiency. The term efficiency can be used in many different ways, but in economics resources are said to be allocated efficiently if it is not possible to reallocate resources, that is to say increase the quantity of some goods or services at the expense of other goods or services, without reducing welfare. A whole branch of economics, known as welfare economics, has developed around the crucial question of how welfare should be defined and measured and how resources should be allocated in order to maximize welfare. The criterion of efficiency that is used as a basis for much of welfare economics is called Pareto efficiency, after the nineteenth-century Italian economist Pareto, who proposed that welfare should be defined as a condition where it is not possible to increase total utility by reallocating resources, if any reallocation which makes one group of individuals better off would make another group worse off. If it is possible to make all groups better off by changing the balance between different goods and services, then resources are not being used as efficiently as possible. If, however, any changes which benefit one group would be at the expense of another group, then welfare is already maximized, and this condition is described as Pareto optimal.

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This concept is relevant to the economics of education since a large part of recent research is concerned with the question of how society's resources should be allocated between education and other forms of investment, or between different types or levels of education, in order to maximize the economic returns. The criterion of Pareto efficiency or optimality suggests that cost–benefit analysis should be used as a guide to resource allocation, in order to show which types of investment are most profitable, and offer the highest rate of return. However, this is still a controversial question in the economics of education, since cost–benefit analysis has not succeeded in measuring all the indirect benefits of education, or of other types of social investment, so that it is not possible to identify optimality.

Nor is economic efficiency the only criterion for decisions about resource allocation. The question of equity is also important, although techniques for measuring efficiency, such as cost–benefit analysis, are not concerned with equity issues. Much recent research in the economics of education has centred on questions of equity, for example how the burden of financing education should be shared between different groups in society. This research will be summarized later in this entry, but first there are other aspects of efficiency which have been extensively explored, and which will now be summarized.

3. The Contribution of Education to Economic Growth

The question of how efficiently society's resources are allocated is crucially linked with the concept of economic growth, usually defined as an increase in the total national income or product. Economists have tried to answer the question of how much education has contributed to economic growth (see *Education and Economic Growth*). One of the first was an American economist, Edward Denison, who used the concept of a production function in order to identify the contribution of different factors of production to the increase in the national income or gross national product (GNP) of the United States between 1910 and 1960 (Denison 1962). Preliminary analysis showed that increases in the quantity of labour and physical capital in the United States did not explain the increase in GNP. There was a large "residual factor" and Denison set out to analyse the components of this residual. He suggested that improvements in the quality of the labour force, including increased education, were important, together with other factors such as technological progress and economies of scale. His analysis then led to the much publicized conclusion that increases in the level of education of the labour force accounted for as much as 23 percent of the annual rate of growth of GNP in the United States between 1930 and 1960 (Dension 1962).

Denison then went on to apply similar techniques to various European countries but his results were less clear cut. Nevertheless the results of his research have been much quoted as demonstrating the link between investment in education and economic growth, and led to a conference organized by the Organisation for Economic Co-operation and Development (OECD) on "the residual factor and economic growth" (Organisation for Economic Co-operation and Development 1964). However, the findings have also been extensively criticized, and it has been suggested that the residual factor is simply a measure of ignorance about the causes of economic growth.

It is now generally recognized that education does contribute to economic growth but that it is very difficult to identify and measure the precise contribution of education relative to other factors. Research has now tended to shift away from attempts to quantify this towards other questions about the efficiency of resource allocation.

4. The Internal Efficiency of Education

The term "efficiency" also refers to the relationship between the inputs and outputs of a process, and can be applied to education in the same way as economists analyse the relationship between inputs and outputs in any productive process, such as manufacturing. The difference between analysing the efficiency of a factory or an industrial process and the efficiency of a school, university, or a country's educational system is simply that it is very much more difficult to define and measure the output of education.

Nevertheless, a considerable amount of research in the economics of education has been concerned with the relationship between inputs and outputs in educational institutions, or in the education system as a whole. This is normally called internal efficiency, in order to distinguish this concept of efficiency from the external efficiency of the allocation of resources within society.

A number of different economic techniques have been used to analyse the relationship between inputs and outputs in education. One of these is cost–effectiveness analysis, which is used to compare the efficiency of alternative ways of achieving the same objective. For example, comparisons between different schools, different types of institution, or different teaching methods may be concerned to show which of the alternatives achieves a stated objective, or level of output, at least cost. Output may be measured in terms of pupil scores in achievement tests or examination results, or simply in terms of pupil-hours, or number of school-leavers, although such measures of output are unsatisfactory because they ignore the quality of education. An alternative approach to cost–effectiveness analysis is to compare two or more schools or other institutions with similar levels of cost in order to identify which achieves the highest level of output from a given quantity of inputs. Once again, however, the main problem is to find ways of measuring the quality as well as the quantity of both inputs and outputs. Examples of cost–effectiveness analysis, for instance comparisons between full-time and part-time study, or studies of the effects of educational television, computers, or other new media on inputs and outputs (Wagner 1982) are discussed more fully in the article on cost–effectiveness analysis (see *Cost-effectiveness Analysis in Education*).

Another technique which is concerned with the relationship between inputs and outputs in education is productivity measurement. This also is an economic technique more usually applied to manufacturing or industrial processes, but equally relevant to education. Productivity is the relationship between inputs and outputs and is measured in terms of output per unit of input. The term labour productivity is used to refer to output per person employed, while total factor productivity refers to the relationship between output and all factors of production, including labour, physical capital (such as buildings or equipment), and raw materials.

Attempts have been made to compare the productivity of education at different periods of time, in order to analyse trends in productivity. This requires information on trends in inputs and outputs, which once again raises the problem of measurement of quality, as well as quantity, of education. Because of the difficulties of measuring the quality of educational inputs and outputs, it is sometimes argued that it is impossible to measure the productivity of education. Other writers go further and suggest that "if education falls into that part of the nation's life where productivity is not a relevant criterion, then it serves little purpose to measure it" (Vaizey et al. 1972 p. 221).

On the other hand, attempts have been made to measure productivity trends in education, despite the difficulties. As one study emphasized:

> Educationists must recognise that if they deny the possibility of measuring educational output or quality this is tantamount to admitting that schools have no way of judging how successful they are in achieving whatever they set out to do. (Woodhall and Blaug 1968 p.4)

It is recognized that it is difficult to define and measure the success of schools "in achieving whatever they set out to do", for the simple reason that education has many different aims and is trying to achieve many different objectives, or outputs, at the same time. In economic jargon the process of transforming inputs into outputs is known as the "production function", and research on the causes of economic growth makes use of the concept of an aggregate production function, for the economy as a whole (Denison 1962). However, there is the difficulty that education represents both an input and an output, since educated manpower is one of the most important inputs of the economy, but at the same time the output of the education system is a significant part of the total national product.

There have been attempts to analyse the production function of education, by examining the outputs of education compared with the inputs (for example, Alexander and Simmons 1975) but one problem is the measurement of one of the most important inputs, namely the time of pupils or students in the educational process. One solution to this problem is to measure the input of pupil time in terms of the earnings forgone by students or pupils, as a measure of the opportunity cost of their time, but once again it is difficult to make adequate allowance for variations in the quality of inputs.

The problems of relating trends in inputs to trends in the output of education are considerable, and this remains a controversial issue in the economics of education. A fuller discussion of this research is given in separate articles (see *Input–Output Analysis in Education*; *Education Production Functions*).

5. *The Demand for Educated Manpower*

Educated manpower is one of the most crucial inputs in the economy of any country, and in developing countries, where there is frequently a shortage of physical capital, the availability of skilled manpower may be particularly crucial. Recognition of the fact that education makes workers more productive, and the belief that shortages of skilled manpower represent one of the major constraints to economic growth in developing countries, has resulted in a great deal of research effort being devoted to the problems of forecasting demand for educated manpower.

The idea that it is possible to forecast or project a country's manpower structure and then to use the result as a basis for planning the scale of education in order to satisfy the economic needs of the country is not only appealing, at first sight, since it appears to offer the hope of unambiguous guidance to educational planners and policy makers; it has also exerted a powerful influence over educational planning in many countries, over a number of years. Economists such as Herbert Parnes advocated educational planning based on what is usually called the manpower requirements approach. He described this in 1962 in an influential report by the OECD in the following terms:

> An attempt is made to foresee the future occupational structure of the economy and to plan the educational system so as to provide the requisite numbers of personnel with the qualifications which that structure demands. (Parnes 1962 p. 15)

This approach, called variously manpower forecasting, estimating future manpower demand, or manpower requirements or needs, dominated educational planning in a number of countries for some years, and still exerts a powerful influence. One of the earliest and most comprehensive attempts to base educational planning on manpower forecasting techniques was the Mediterranean Regional Project (see *The OECD's Mediterranean Regional Project*) which was established by the OECD in the early 1960s in six Mediterranean countries: Greece, Italy, Portugal, Spain, Turkey, and Yugoslavia.

Detailed forecasts of the manpower requirements of these countries over a 15-year period were drawn up and these forecasts were used as a basis for estimating the number of places to be provided at each level of education, together with the number of teachers and the capital expenditure that would be necessary to produce the desired rate of increase in the supply of qualified manpower.

However, many economists challenged the validity of manpower forecasting, on the grounds that the assumptions of this approach were mistaken. The underlying assumptions of any forecast of manpower demand or requirements are that:

(a) there is a fixed and stable relationship between the level of educational qualifications of workers and the level of output of an industry or sector of the economy;

(b) there is also a rigid relationship between the occupational structure and the educational qualifications of workers; and

(c) it is therefore possible, and desirable, to make long-term forecasts of future levels of output and the occupational structure and educational qualifications of the labour force that will be needed to produce that output.

Economists who challenge these assumptions argue that it is possible to produce the same level of output with different combinations of inputs, that there are no fixed educational requirements for the majority of jobs, and it is impossible to make accurate long-term forecasts because of the problem of predicting technical change. Many who oppose the manpower forecasting approach advocate cost–benefit or rate-of-return analysis of education, on the grounds that this takes account of the possibility of varying the proportions of different inputs, including labour or capital, or qualified and less qualified manpower (i.e., the elasticity of substitution), and takes explicit account of the costs of education, which tend to be disregarded by an approach which emphasizes "requirements" or "needs".

The controversy between the manpower forecasting approach and cost–benefit analysis attracted considerable attention during the 1970s. One attempt to evaluate manpower forecasts in eight countries concluded that:

> The manpower forecasting methods in current use certainly can lead to erroneous policy decisions . . . there are important weaknesses in the methods that have been used to make manpower forecasts . . . (which are) subject to large errors . . . We are, therefore, driven to the central conclusion that manpower forecasting has not so far proved to be particularly useful for educational decision-making; we may even go so far as to say that it has on occasion been positively misleading. (Ahamad and Blaug 1973 pp. 313–33)

More recently a review of experience in eleven countries (Youdi and Hinchcliffe 1985) concluded that while detailed forecasts "need to be regarded with much scepticism", manpower *analysis* rather than manpower *forecasting*, is necessary. On the other hand, other economists are equally sceptical about the validity and accuracy of techniques of cost–benefit analysis. Blaug has summarized the controversy between advocates of a manpower forecasting approach and a cost–benefit approach to planning in terms of "two views of the state of the world" (Blaug 1970). The disagreement is, fundamentally, one about the degree of flexibility in the economy and the labour market. Manpower forecasting rests on assumptions of a set of fixed or rigid relationships between inputs and outputs and between educational qualifications and jobs. Cost–benefit analysis, on the other hand, assumes flexibility and substitutability between different factors of production, not only between different types of manpower but also between labour and capital.

Research in this area now suggests that economic systems are in fact more flexible than manpower forecasters usually assume, but subject to more rigidities and market imperfections than is assumed by cost–benefit analysis. Blaug characterizes the dispute in terms of two views of the state of the world, but admits "Needless to say, the real world lies somewhere in between" (Blaug 1970 p. 216).

A technical evaluation of the Mediterranean Regional Project exercise (Hollister 1967) suggested that there were greater possibilities for flexibility and substitution than were assumed in the manpower forecasts, pointed out that "the problems raised by uncertainties about productivity change (technological change) loom quite large", and concluded that ignorance about the relationships between education and occupation is "the weakest link in the manpower requirements estimating procedures" (Hollister 1967 p. 72). Nevertheless, this evaluation did not reject manpower forecasting, but argued that instead of providing single-valued forecasts, on the basis of rigid assumptions, planners should use sensitivity analysis to test the implications of alternative assumptions and should attempt to integrate the various approaches to educational planning. Hollister concludes:

> In reviewing the arguments over which "approach" to educational planning is the "right" one, it becomes clear that when one views the educational system as a whole, and, more generally, the educational complex as an element within the overall social and economic system, all of these "approaches" fit together within the logic of the total system. (Hollister 1967 p. 76).

Similarly, Blaug (1967 p.287) argues that "social demand projections, manpower forecasting and rate of return analysis are reconcilable and in fact complementary techniques of educational planning". In fact, the literature on the economics of education is no longer dominated by the disagreements between advocates and critics of manpower forecasting, but the dispute remains, mainly as a matter of differences in hasis and ideology, as another review of the contro- ersy makes clear:

> idently both manpower planning and rate-of-return approaches have severe limitations. The contrasts between them have roots deep in the ways men look at political- onomic systems and in the controls over those systems that are attempted in practice. (Anderson and Bowman 1967 374)

A recent analysis of investment choices in education charopoulos and Woodhall 1985) examines all three proaches in the light of research by the World Bank.

The Finance of Education

her issue in the economics of education on which ere are ideological differences is the question of how tion should be financed, in particular how the ancial burden should be shared between the govern- employers, and individuals, and what should be balance between public and private sources of ance.

s is a question which has both efficiency and equity plications. The question of how the financial burden be distributed raises the question of the extent the public and private benefits of education which already been discussed. Measures of the rate of to educational investment relate the public or vate benefits to the costs of education, and the social return measures the benefits that are enjoyed by iety as a whole, compared with the total resource of education, whereas the private rate of return ludes the direct benefits that are enjoyed by the ividual, compared with the costs which are borne by dividual or his or her family.

The difference between the social and the private rate rn thus reflects the degree of public subsidy of ication, and since education is, in general, highly ized, there is usually a wide gap between social private rates of return. If individuals were expected contribute a greater share of the costs of education elves, by means of fees or some other form of ment, then the gap between the social and the pri- te of return would be reduced. However, there very few cases where individual students are ected to pay the whole of the costs of their education nselves, and thus private rates of return exceed al rates of return.

ost countries a significant part of the costs of cation, particularly at the primary and secondary re met out of general taxation or other govern- nt revenue, and pupils receive free schooling or pay fees. In the case of private schools, fees may be a tantial or even the only source of revenue, but even e case of private schools there is often some degree ic subsidy, either by means of tax concessions for tutions, or direct subventions for teacher salaries. In ountries fees are charged in institutions of higher cation, but these are often well below the true resource costs (and therefore the social cost) of higher education. In addition many students receive financial aid in the form of scholarships, bursaries, grants, or subsidized loans, which help to reduce the financial burden of fees or of the students' living expenses. In either case, student aid reduces the private costs of education and therefore increases the private rate of return.

Economic theory cannot answer the question of who should pay for education, but it can throw light on both the efficiency and equity implications of alternative methods of financing education. The question of how society's resources are allocated between competing ends and whether this is efficient in terms of maximizing social welfare is, as Sect. 2 has already made clear, a crucial part of economic theory and the principle of Pareto optimality suggests one criterion for judging efficiency. However, this is not the only criterion that is relevant to the question of how education should be financed.

Since education confers financial benefits on the individual, in the form of higher lifetime earnings, the question of who pays for the education raises important questions of equity, as well as efficiency. If educational opportunities are unequally distributed, because of inequalities in the distribution of income, and hence the capacity of individuals to finance investment in education, then this will perpetuate inequalities of income in the future, since earning power is related to a worker's education. Thus, the question of who should pay for education is closely linked to the question of equality of educational opportunity, as well as the question of equity. The title of one American book sums up the dilemma: *Higher Education: Who Pays? Who Benefits? Who Should Pay?* (Carnegie Commission on Higher Education 1973).

This issue has provoked considerable controversy, particularly in the United States, since one widely publicized study of the benefits, costs, and finance of public higher education in California (Hansen and Weisbrod 1969) concluded that the general effect of public subsidies for higher education in California is to promote rather than to discourage inequalities of income. The reason is that those who are most likely to benefit from higher education are the children of upper-income families, so that the authors concluded, after analysing data on lifetime earnings differentials and relative tax burdens, that subsidies for higher education involve a transfer of income from the average taxpayer to those who come from higher than average income families and who may expect to earn higher than average incomes in the future.

This research has been extensively debated in the United States and has aroused considerable controversy, as other writers have analysed similar data for California or for other states, and have come to different conclusions (Pechman 1970, Hight and Pollock 1973). More recently there has been research on the effects of education subsidies in developing countries, which also

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throws doubt on the assumption that providing free or subsidized higher education will benefit low-income families, since it is the sons and daughters of upper-income families who are most likely to benefit from higher education (Psacharopoulos 1977a). However, when subsidies for lower levels of education are also taken into account, it is possible that subsidies for education may contribute to a redistribution of income in developing countries (Jallade 1974) although it is not necessarily so.

Apart from studies of the distribution effects of public subsidies for education there have been a number of studies of the effects of alternative methods of financing education. The two topics that have attracted most attention are student loans and the idea of financing education by means of vouchers.

The question of whether students should receive financial aid by means of grants, loans, subsidized work-study opportunities, or a combination of different forms of aid has provoked some controversy in Europe and the United States, although the majority of countries now provide aid for students by means of a combination of grants and subsidized loans. Japan is one of the few countries where loans are used almost exclusively, and the United Kingdom is one of the few Western countries which provides only grants. Canada, the majority of European countries, and the United States provide a mixture of grants and loans, and loans are also extensively used in South America to provide financial support for students. There has been research on the effects of student loans and comparisons of different types of student support schemes in developed countries (Woodhall 1978, 1982) and the question of student aid policy in developing countries is now attracting increasing attention (see *Student Loans*).

The idea of financing education by means of vouchers, however, has not been widely put into practice, although it has been the subject of considerable discussion. The idea, put forward in both the United States and the United Kingdom, is that parents should be given a voucher which could be used to purchase education for their children, at the school of their choice. Schools would charge fees and the vouchers would be used to meet all or part of this cost. The role of the government would be confined to the financing of schools, rather than the actual provision of schooling, and it is argued that this would encourage competition between schools or other institutions, and would increase parental choice.

In the United Kingdom advocates of vouchers have argued that while there are strong arguments in favour of state intervention in education this need not imply state provision, and they suggest that a system of vouchers would make schools more responsive to the wishes of parents, or students, and thus increase efficiency (West 1965). In the United States there have been proposals to provide vouchers of varying value for different population groups, so that children from low-income or deprived families could be given the advantage of a compensatory voucher of higher than average value. One attempt to experiment with vouchers in the district of Alum Rock, California, was widely reported and investigated, but produced fairly ambiguous results. There is very little empirical evidence on the effects of financing education in this way.

7. *Equity and Efficiency*

The two criteria of equity and efficiency, which are of crucial importance in debates about educational finance, are also relevant to studies of resource allocation. There has been a striking change in emphasis in recent years in many of the studies in the economics of education. One review of "recent methodological advances and empirical results" suggested that the main shift in emphasis in the economics of education was a shift of concern from efficiency to income distribution.

> No one would disagree that this is the number one shift that has taken place in the economics of education. When the concept of investment in education was first discovered, in the late fifties, it was natural for researchers to try to assess the profitability of this new kind of investment. Once this curiosity had been satisfied, the next question was: what has education to do with income distribution in our society? Does schooling act as an equaliser or as a transmitter of the status quo from generation to generation? One big question . . . is if there exist any trade-offs between the efficiency and equity effects of education. (Psacharopoulos 1977b)

Although this question has not yet been answered, the two concerns of equity and efficiency continue to dominate the economics of education.

8. *Reviews of the Literature*

This article can do no more than summarize the main areas and topics which have been studied in the economics of education in recent years. The literature is now vast, and has grown rapidly. A bibliography of the subject by Mark Blaug was first published in 1966, with nearly 800 items, but the third edition, published in 1978, contained over 2,000 annotated entries (Blaug 1978). Blaug has also written an introduction to the economics of education (Blaug 1970) which reviews research in both developed and developing countries and there are a number of American textbooks on the subject (for example, Cohn 1972) and a number of books of readings, which provide useful compendia of significant studies and research (UNESCO 1968, Blaug 1968, Baxter et al 1977). More detailed summaries of research will be found in the individual articles to which references have been made in this overview.

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PART I

The Formation of Human Capital

Education and Population Quality[1]

T. W. Schultz

It is useful to think of population quality as derived from two sources, namely, genetic endowment and acquired abilities. Education is a major source of acquired abilities. The economic implications of innate abilities are not dealt with in this article. Although the genes that a person possesses matter, only acquired abilities are discussed here because as far as we know, the distribution of genes within large populations are about the same. Thus, for example, there is no appreciable difference in the level and distribution of the genetic endowments between the people of the People's Republic of China and that of the United States population. The vast difference in the level of abilities between them is a consequence of the difference in acquired abilities, which are treated here as forms of human capital. The per capita human capital is small in the People's Republic of China and very large in the United States.

During the several decades prior to the 1980s, the concept of human capital has acquired a substantial place in the analytical mansion of economics. It took decades to rediscover the theoretical architect Irving Fisher, a great economist who saw clearly and cogently that all scarce entities (resources) that render economic services are forms of capital and that the services from the total stock of capital at a given date are the available income streams. Thus, economic growth is a consequence of additions to quantity and quality of the stock of capital which contribute to total income.

There are five analytical issues to bear in mind. First, it is essential to use an all-inclusive concept of capital. Second, the value of each form is the capitalized value of its income stream. Third, since the investment opportunities change as economic growth proceeds, inequalities in prospective returns become evident. The optimum private and public response is to invest in those forms of capital that are most likely to produce income streams that can be had at the lowest cost. Fourth, each form of capital is two-faced, and what these two faces tell us are, as a rule, inconsistent stories. It is so because the cost story is a tale of sunk investments. Horsedrawn equipment has little value when tractors replace horses. The other story pertains to the changes in the future discounted value of the income stream that an addition to the stock of capital will render because of the shifting economic sands over time. Fifth and last, the assumption of capital homogeneity, on which capital aggregation rests, is the disaster of capital theory. The dynamics of economic growth is afloat on capital heterogeneity.

The common view of capital is confined to material things. Physical capital, however, accounts for a small part of the total stock of capital in countries that have achieved a high level of per capita income. Moreover, physical capital consists in large part of knowledge: for example, advances in knowledge made the computer, modern communication facilities, and the high-yielding crop varieties possible. The vast improvements in the quality of most physical capital over time could not have been made were it not for advances in knowledge.

It is not usual to think of acquired ability as capital. The value of this human capital is revealed in wages, salaries, and in entrepreneurial rewards, along with the additional personal satisfactions that people derive from their acquired abilities. Here, too, and in large measure, the quality of human capital is enhanced over time by advances in knowledge. Engineers who graduate currently will have learned many things in their field of specialization that were not known and, therefore, not taught to engineers who graduated in earlier years. It is also true for scientists, medical personnel, and even for economists. In retrospect, the stock of human capital has been increasing at a higher rate than that of physical capital.

There is also a stock of knowledge that is not embodied in physical capital. Nor is it a part of the human capital that can be so identified and measured. It is a stock of "common knowledge" that is pervasive in the social environment of a society. It has a value and it therefore has the attributes of capital, although it is neither private nor public property in any legal sense. Understanding the requirements of achieving economic efficiency is a case in point. It differs greatly among countries. It is exceedingly difficult to get an analytical grip on it and to get at the reasons why the differences among countries in this form of knowledge persist for long periods of time.

This stock of "common knowledge" that is a part of the social environment also affects the performance of organized education. Consider the economy of any country. Its growth depends fundamentally on increases in the quantity and quality of resources and on economic efficiency. Correspondingly, education depends basically on the additional quantity and quality of its personnel and other inputs and on the economic efficiency of its organization. Agriculture is instructive on this point. High-yielding crop varieties, fertilizer, insecticides, tractors, combines, experiment stations, and well-trained agricultural scientists and related technical personnel are all more or less necessary, but they are not sufficient. Wherever the economic organization of agriculture is inefficient, production languishes even though the quantity and quality of the inputs are at hand along with a high order of technical services. In terms of the technical requirements listed above, agriculture in the Soviet Union should be highly productive. But it is not. The reason it has failed is the inordinate economic inefficiency which is a consequence of the economic organization of Soviet agriculture.

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[1] This article is based in part on the author's *Schooling and Higher Education: An Economist's View.* Human Capital Paper No. 82-13. Department of Economics, University of Chicago.

1. *Education as Human Capital*

The formation of human capital by education has been high on the research agenda of an increasing number of economists. It has been so because the effects of education on economic activities are pervasive. It is now well-documented that the acquisition of abilities and advances in knowledge is in substantial part a product of deliberate investment, that such investments enhance the value of human time, that the allocation of time is a major pervasive part of economic activities, that the value of human time of women has strong measurable effects on the time that they allocate to household production, to participating in the labor market, and to the bearing and rearing of children, and that the concept of human capital greatly extends the understanding of the productivity of labor.

It has long been known that increases in national income have been larger than increases in land, in physical reproducible capital, and in man-hours. It is now known that investment in human capital is a substantial part of the explanation of increases in national income that had heretofore been left out of the accounting.

The distinctive attributes of education as human capital that consist of acquired abilities are worth noting.

(a) An individual's stock of human capital cannot be sold, nor can it be given to someone else. It goes with the individual wherever he or she may go. If an individual were to migrate to another country, the government cannot confiscate that person's human capital. Jews and other ethnic groups facing discrimination and the danger of being expelled have known this fact for ages.

(b) To take advantage of human capital, an individual must do it in person.

(c) The duration of the value of an individual's human capital cannot exceed his or her life span.

(d) In acquiring human capital the individual must invest some of his or her own time along with other resources, for example, in acquiring an education and the services of instructors.

(e) It is efficient to invest in human capital during the period of youth because the value of time is less then than it is when the individual grows older and because there will be a greater number of years in which to benefit from the acquired human capital.

(f) Human capital depreciates over time as does physical capital. Some forms become obsolete in a short time because of changing circumstances. Other forms have a long life even as circumstances change. It is exceedingly important to distinguish between short and long life investments, especially so in the case of education.

(g) Women, for good reasons, invest in somewhat different forms of human capital than men.

Ideally one would learn to think as cogently as Einstein, would acquire the ability to express hope and beauty as did the Russian poet, Anna Akhmatova, speak as plainly and profoundly as Lincoln did, and become as strong and responsible a private and public person as Thomas Jefferson.

As in the case of physical capital, not all forms of human capital turn out to be worthwhile investments. The choice is for the individual to make. It matters whether or not the choice is made wisely.

2. *Issues that Matter*

Agriculture and education have one important attribute in common, namely, when they are centrally controlled, the performance of farms and schools languishes. As organized economic activities, the size of the decision-making entity matters greatly. The efficient scale of farms and schools is not like that of General Motors or US Steel. It is noteworthy that these two industrial giants are presently not sufficiently efficient to meet foreign competition. In countries the world over, where governments plan and manage agriculture, the production records are bad.

The very large school systems in many large cities of the United States are controlled by an incongruent combination of city politics and state and federal regulations. Superintendents, teachers, students, and parents have become mere pawns. The result is that the quality of the schooling is bad. Many university campuses measured by enrollment have become gigantic organizations. The enrollment data given here are for the fall of 1980 (National Center for Education Statistics 1982). The largest 10 ranged from 37,000 to 65,000 students. There were 33 campuses with more than 30,000 students. The smallest of the 60 largest universities reportedly had 24,000 students. All 60 of these huge conglomerates are public universities. In large measure, the quality of instruction received by many undergraduates who are enrolled in these very large universities is bad.

Quality can be measured in various ways. A look at the origins of American scientists and scholars is one important quality clue. Hardy's study (1974) is based on 295 baccalaureate institutions which were the sources for 100 or more doctorate recipients in the years 1920 to 1961. The most productive 20 percent are predominantly small private colleges. Neither Harvard nor Yale appears among Hardy's top 59 institutions.

As economic growth occurs over time economic disequilibria are inevitable. They cannot be averted by laws, public policies, and surely not by rhetoric. Education is not spared from the effects of these disequilibria. Both

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Parents in responding to educational opportunities for their children and students are not robots. From the perspective of economics, they are calculating economic agents. Thus, costs, expected rewards, and incentives are important.

Most educators and economists fail to comprehend the significance of the experience that poor people throughout the world have acquired over many generations. To see them as illiterate, as having a short life span, as eking out a meager existence under adverse economic circumstances, conceals their long-established civil arrangements and humanity. They possess a human legacy that the family in large measure has maintained and transferred from generation to generation.

3. *An Assessment*

In assessing investment opportunities, it turns out that on the whole investment in human capital is a long-term venture. In the developed countries the formal education of children requires many more years than it takes to construct a complex industrial plant. The three parts of this assessment are: (a) the time dimensions of the cost and returns; (b) particular institutional limitations that impair the efficiency of investments in people; and (c) choices that might be made to improve this investment process. Everywhere people are constrained by a scarcity of resources in satisfying their wants. Resources the world over have always been and always will be scarce and people will continue to have preferences and unsatisfied wants. Human beings are calculating economic agents. They are constantly reassessing their economic opportunities as circumstances change. Natural resources and the stocks of reproducible physical capital are passive economic entities. People are the active agents. Thus, in a fundamental sense, all actual economic activities are in essence human endeavors. This is so throughout the world, be it poor or rich countries, or centrally planned or market-oriented countries. For reasons of the differences in economic organization, the economic efficiency of people as economic agents varies greatly among countries.

3.1 *Time Dimensions*

There is for humankind a biological and an economic time horizon. Plant corn in May and the harvest should be completed during November. Provide child care, health, and education, and the costs will keep on mounting for years, but if all goes well, the rewards will also have long time dimensions. Differences in life expectancy and in the expected rate of returns are important.

Our life spans have become very long compared with those of preceding generations. People are fortunate if they invest in skills during their youth that will enhance their productivity during the years they work and that will also add to their personal satisfactions during their working years and during their retirement. Leaving the effects of the genetic endowment aside, investment in the acquired stock of health and in maintaining it, especially during the later years, is of major importance. Although the twentieth century has been an era of increasing specializations, it is wiser to invest in general human capital than in specific human capital; this applies especially to schooling and to early parts of higher education.

3.2 *Institutions*

As critics of society's institutions, economists are custodians of the long view in economic matters. They hold fast to the gains to be had from free trade. In times past, they criticized the economic doctrines of the church, of the state, of the landlord property class, and of the mercantilist. At the present time, the long-run adverse economic effects of various economic entitlements that have been institutionalized are lost sight of except by some old-fashioned economists who have freedom of inquiry or who for reason of age are secure. Economic entitlements have grown like Topsy. Each organized group is bent on enlarging its quotas—be it for business, labor, agriculture, the environmentalist, or for the recipients of social services and income transfers.

The economy is a part of a complex set of institutions. A steady state of growth, which is the Holy Grail of some macroeconomists, is thus far beyond the capacity of society's institutions. A high rate of inflation impairs the process of investment with respect to the United States economy. When more than 20 percent of the industrial capacity is idle and over 10 percent of the labor force is unemployed, where are the investment incentives to increase the stock of either physical or human capital? The rates of return to education declined substantially during the latter part of the 1970s and subsequently. It is not that Americans are overeducated any more than the United States industrial plant is too large and too modern. What is true is that the investment incentives have been depressed and distorted by the poor performance of the economy.

Once again, with respect to the United States, public schools have long been an established institution. In most of our large cities, public schools are now performing badly. In terms of national test scores, the children who attend public schools in these large cities have test scores that are far below the national norms. Social reforms that use these schools as a major instrument to achieve these reforms have become the order of the day. Many parents know that the quality of the schooling that their children receive is inadequate, but there is little they can do about it except change their residence, or opt for private schools and pay both school taxes and tuition. National social reforms have mandated equity but it has not been achieved. They have, however, contributed to the decline in the quality of schooling (Schultz 1980 Chap. 5). Politics is much to blame. Unfettered competition between public and private schools is an essential part of the solution.

An optimum level of efficiency in large city school systems would in all probability contribute more to the cause of equity than the many reforms now being imposed.

3.3 Choice

Taking the long-term view of investing in people, several questions arise. From childhood on, how soon and to what extent is it best to specialize in acquired abilities? Specialization has a high rate of obsolescence. At what age during a person's life cycle should most investments in acquired abilities be made? The answer is, during that person's early years. Why should the public pay for a part of this investment in abilities when the returns come to people privately? As a voting citizen, is it possible to identify and distinguish between public and private returns when investments are made in people? These are some of the questions that are faced in making choices.

There are five choices related to these issues:

(a) Young people are well-advised to plan on increasing their stock of human capital with an eye on the decades ahead when the economy will reward them for the investment. It entails a risk, but that risk is well worth taking.

(b) It is possible to revitalize the elementary and secondary education in the large cities, a task that is long overdue. The key to this task is to minimize the adverse interventions of the federal government, of state governments, and of the politics of most large cities. It is up to the respective electorates to demand that the necessary political reforms be made. The political system of the United States has the virtue that it does respond. The supply of good teachers is large. Parents want a better deal for their children. Although the leadership of the National Education Association wants to maintain the status quo of all public schools, that leadership cannot be allowed to dictate national public school policy.

(c) The regulations and interventions of the federal government pertaining to universities in the United States must also be minimized. Here, too, the electorate can achieve this objective.

(d) The economic signals and incentives to invest in education are to a considerable extent distorted by private and public constraints on competition. The implication is that the prices of some products and factors used in production, including some of the prices of human time, are not their true economic values. Many people who engage in business and farming want protection from competition. So do some elements of labor, more the highly skilled than the unskilled. Professional people want to be sheltered from competition. Organizations representing those various groups lobby for special advantages each for its particular client. Antitrust laws have their limits. The pragmatic politics of United States cities and federal and state governments impair competition by all manner of means. It is exceedingly important for the electorate to hold fast to open unfettered international trade because it is a primary way of enforcing viable competition.

(e) Lastly, the stock of common knowledge that is essential to conduct economic affairs efficiently varies greatly among countries. It is much easier to learn how to use advances in technology than it is to learn the institutional requirements for an efficient economy. Despite all the economic shortcomings of the United States, stock of common knowledge on this score is far better in that country than it is in most low-income countries. There are exceptions, which include Singapore, Hong Kong, and the Republic of China (Taiwan). Furthermore, in the United States this knowledge base is vastly superior to that of the Soviet Union, of the East European countries that are beholden to the Soviet Union, and of the People's Republic of China.

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Knowledge Industries and Knowledge Occupations

F. Machlup

Knowledge industries and knowledge occupations are convenient terms to denote the total activities in an economy undertaken with the intentions to create, transmit, and receive knowledge. The purpose of these activities may be to sharpen and enrich people's minds; to inform, enlighten, advise, and entertain; to improve the understanding of nature and society; to increase the efficiency of work and of production processes; or to serve any other aims. There are two approaches to the economic analysis and statistical measurement of these edge acquired in passive relaxation from serious pursuits);

(d) spiritual knowledge (religious instruction about God and the salvation of the soul); and

(e) unwanted knowledge (knowledge outside the recipient's interests, perhaps accidentally acquired and aimlessly retained).

Strictly speaking, the application of these categories in particular instances would require awareness of the knower's motivations and intentions; but by thinking of typical recipients of the various types of information one may use the categories to describe the composition of the output of some of the knowledge industries.

The concept of truth is not a part of the definition of knowledge used here. This becomes immediately clear when one remembers that knowledge is not always embodied in language but includes paintings, sculptures, and music; and in linguistic expression it includes literature (fiction and poetry) that does not pretend to convey literal truth. Even scientific knowledge is always subject to revision and amendment; it never pretends to be more than a tentative approximation to the truth. Only for practical knowledge does it really matter that it be true and accurate enough to enable those who use it as a basis for action to get what they want.

3. The Demand for Knowledge

Only a part of the nation's production of knowledge is guided by the market mechanism. Much, perhaps most, of the knowledge produced is not purchased by the consumer at a price but is offered to him free of charge. The largest item in most countries is the expenditure for schools and universities, paid for largely by government, with smaller portions defrayed by philanthropists, parents, and the students themselves; the content of the teaching is determined partly by a political process and partly by professional educators.

Another large item, though only in a few countries, is the cost of research and development; the projects are often selected by the government, which usually pays for a large percentage. Radio and television are paid for by government in many countries, but by commercial sponsors in some countries, including the United States; the programs are chosen on the basis of either what the masses of the audience seem to like best or what is thought to be good for them. For large parts of the output of the knowledge industry there can be much controversy regarding what the people want and what they ought to want or would want if they were better prepared to make their choices.

4. The Difference Between Knowledge Industries and Knowledge Occupations

A knowledge industry is defined as a group of firms, institutions, or any other organizations, or of departments or teams within them that incur or induce costs, explicit or implicit, to create or disseminate knowledge of any type. Since the supply of information is sometimes inseparably connected with the supply of other goods or services, we count among the knowledge industries only those suppliers who provide information not merely as a minor by-product of other activities but as one of their major functions. But we include not only those knowledge suppliers who sell their services but also those who distribute them free of charge, financed by the taxpayer, by philanthropists, or by business.

Not all workers employed in a knowledge industry are knowledge workers. For example, schools and universities in the education industry employ cleaning personnel, janitors, and mechanics whose work is physical, not mental. The publishing industry employs not only writers, reporters, editors, printers, and proofreaders, all of whom perform chiefly mental work, but also chauffeurs, truck loaders, warehouse personnel, bookbinders, and many others whose work is chiefly manual; it has the journals and books printed on paper produced in mills that employ mainly physical workers, use machines made of steel and copper, and fabricate pulp from wood that was cut by lumber workers. Thus, while the output of the publishing industry is designed to transmit knowledge, a large component of the input is the labor of workers who are not in knowledge occupations. Likewise, the industry manufacturing computers and other information machines employs a majority of manual workers. In other words, to be employed in a knowledge industry does not transform a manual worker into one who performs knowledge work.

On the other hand, not all workers in knowledge occupations are employed in knowledge industries. Many such workers are employed in industries producing physical goods. No industry, whatever it produces, can be operated without some workers whose chief task is mental. To mention a few examples, the chemical industry employs chemists for research, development, and testing; it employs stenographers, typists, accountants, and other clerical workers, a sales staff that never has to do any physical labor, and many others whose work is mental, not physical. Likewise, the textile industry employs designers and again the nonphysical workers in the sales department, accounting department, secretariat, and so forth. Moreover, no firm can be without management, and managers are knowledge producing in that their task is to receive and evaluate information, to make judgments and decisions, to give orders and instructions, and direct the operations of the firm.

Now that the difference between knowledge industry and knowledge occupation has become clarified, one may raise the question whether the number of nonknowledge-producing workers employed in knowledge industries is greater or smaller than the number of knowledge-producing workers in nonknowledge industries. The answer, however, depends to a large extent on arbitrary classifications. For example, if one regards all research and development as a knowledge industry even where the work is undertaken not in separate firms or institutions but in departments or teams within firms engaged in manufacturing physical products that have nothing to do with knowledge production, one has arbitrarily lifted parts of nonknowledge branches of industry and transferred them into the column headed "knowledge industry."

The statistical decision to regard all research and development as a separate knowledge industry has suggested itself by the availability of statistical measurements that included both types of research and development: not only that performed by agencies, firms, and institutions specialized in research and development, but also that performed within firms (or other organizations) for internal use, as part of an integrated industry. There is a justification for this manipulation of statistical data. If an automobile manufacturer operates a steel mill, it makes good statistical sense to report steel production separately from output of automobiles and include it with the output of the steel industry. Likewise if a steel producer operates coal and iron ore mines, it is sensible for the statistician to disintegrate the output of the firm and transfer the respective data to the coal mining and iron ore mining industries. The analogous treatment of research and development transforms integrated operations by thousands of firms in a large variety of industry branches into a separate industry. The procedure still remains arbitrary; for example, we could with equal justification show an accounting industry that would include, besides the information services provided by specialized auditing and accounting firms and by independent accountants and tax counselors, all the accounting departments of large corporations and even the bookkeeping performed with the smallest firms.

As long as this statistical disintegration (for the purpose of an aggregation serving a different purpose) is done only for some and not for all production of knowledge for "internal use," the question of the relative magnitudes of the total knowledge industry and of the total knowledge labor force is not really meaningful. What is meaningful, however, is a comparison of growth rates of the two magnitudes.

5. *Knowledge Industries Enumerated*

In a statistical survey of the output produced by knowledge industries, the following six industry groups may be included: education; research and development; artistic creation and communication; media of communication; information services; and information machines. These groups are subdivided in the following branches:

5.1 Education

(a) Education in the home.
(b) Training on the job.
(c) Education in the church.
(d) Education in the armed forces.
(e) Elementary and secondary schools (monetary expenditures and implicit costs).
(f) Colleges and universities (monetary expenditures and implicit costs).
(g) Commercial, vocational, and residential schools.
(h) Government programs for education not elsewhere counted.

5.2 Research and Development

(a) Basic research.
(b) Applied research and development.

5.3 Artistic Creation and Communication

(a) Literary arts: poetry, fiction, playwriting.
(b) Music: vocal music, instrumental music, symphonic music.
(c) Performing arts: theatre, opera, dance.
(d) Motion pictures and cinema.
(e) Visual arts: drawing, painting, sculpting.
(f) Architecture.
(g) Museums and art galleries.

5.4 Media of Communication

(a) Printing and publishing: books and pamphlets, periodicals, journals, magazines, newsletters, newspapers, stationery and other office supplies, commercial printing and lithography.
(b) Commercial photography and phonography.
(c) Oral and visual communications: from the podium and screen, spectator sports.
(d) Electronic media of communication: radio stations revenue, television stations revenue, radio and television sets and repairs, radio and television stations investment.
(e) Other advertising.
(f) Addressed communications: telephone, telegraph, postal services.
(g) Conventions and conferences.

5.5 Information Services

(a) Libraries.
(b) Science and technological information.

(c) Professional services: medical services (excluding surgical), legal services, engineering and architectural services, accounting and auditing.

(d) Other specialized information services.

(e) Business information services.

(f) Information joint with financial services: deposit banking and money market funds, securities exchanges, brokers, dealers and analysts, insurance agents.

(g) Information joint with trade: real-estate agents, wholesale agents, miscellaneous business services.

(h) Management as an information process.

(i) Government: legislature, judiciary, executive, regulatory agencies.

5.6 *Information Machines*

(a) Printing machines.

(b) Musical instruments.

(c) Motionpicture apparatus and equipment.

(d) Telephone and telegraph equipment.

(e) Signaling devices.

(f) Measuring and controlling instruments.

(g) Typewriters.

(h) Electronic computers.

(i) Other office machines.

(j) Office machine parts.

The statistical data for these branches of knowledge production can be broken down by the source of funds paying for the activity—government, business, or consumers—and by the character of the output, either intermediate product or final product (the latter being either consumption or investment). Regarding the second breakdown, it proves necessary to dissent from some of the characterizations made in the official statistics of gross national product (GNP). For example, the GNP statistics of the United States Department of Commerce regard research and development as final product when the expenditures are paid by the government, but as intermediate product when paid by business; it is more reasonable to treat these outlays uniformly as investment (even if business firms, in computing their taxable incomes, include them as current cost of producing whatever product they sell). For analogous reasons, broadcasting over radio and television is more properly characterized as final product—as consumption, not investment—even where business pays for it as a tax-deductible advertising expense. The largest part of the cost of education is the income that employable students over 14 or 15 years of age forgo by studying rather than taking jobs; this does not appear in the GNP, but may properly be regarded as investment, social as well as private.

6. *Statistics of Knowledge Industries*

A computation for the United States (Machlup 1962) yielded the findings given in Table 1 for the total cost of knowledge production in 1958. Total knowledge production in the United States was, in 1958, 29 percent of GNP, after the latter was adjusted for the various changes appropriate for the purpose.

No analogous statistics have been prepared for other countries, probably because it is difficult to obtain the relevant data from the conventional national income accounts. From these accounts one may at best obtain the output of so-called "primary" knowledge industries, that is, those that sell "final" product to the market or distribute it to consumers. The output of the so-called "secondary information sector," which produces information chiefly for internal use within the firm or within the same industry, is much more difficult to estimate. Porat and Rubin (1977) estimated outputs of both primary and secondary information sectors in the United States for 1967. Their estimate for the primary sector was 25.2 percent and for the secondary sector 21.2 percent of GNP, together 46.4 percent. This tallies reasonably well with Machlup's estimate of 29 percent for the year 1958, accounting for growth during the nine years.

Estimates for the primary information sector have been supplied by the Organisation for Economic Co-operation and Development (OECD) for several industrial countries. Relative to gross domestic product the primary information sector accounted for 24.8 percent in the United States in 1972 (a little less than in 1967), 22.0 percent in the United Kingdom in 1972, 18.5 percent in France in 1972, 18.8 percent in Japan in 1970, 16.9 percent in Sweden in 1970, and 14.6 percent in Australia. The share of the cost of education (excluding implicit costs, such as forgone earnings) in these esti-

Table 1
Costs of production of knowledge in the United States, 1958

Classified by industry branches (%):	
Education	44.1
Research and development	8.1
Media of communications	28.1
Information services	13.2
Information machines	6.5
Classified by source of funds (%):	
Government	27.8
Business	30.9
Consumers	41.3
Classified by character of product (%):	
Intermediate (current cost)	20.0
Final (consumption or investment)	80.0

mates of the primary information sector varied between less than one-sixth and almost one-third.

7. Knowledge Occupations

Knowledge workers are engaged in producing effects on their own minds or on the minds of others. Activities of the former type include watching, listening, reading, experimenting, inferring, intuiting, discovering, inventing, interpreting, computing, analyzing, judging, and evaluating. Activities of the second type include talking, writing, typing, printing, gesturing, signalling, drawing, painting, sculpturing, singing, and performing. All these activities may serve different purposes; for example, one may talk as a teacher, actor, priest, supervisor, manager, counselor, legislator, physician, and in many other types of knowledge occupations.

One may classify knowledge workers according to the degree to which messages which they deliver or transmit differ from the messages which they have previously received. Eight such classes or levels can be distinguished:

(a) transporters,
(b) transformers,
(c) routine processors,
(d) discretionary processors,
(e) managerial processors,
(f) interpreters,
(g) analyzers, and
(h) original creators of knowledge.

The transporter of information delivers exactly what he has received. The transformer changes the form of the message, but not the contents (example: stenotypist). The processor changes both form and contents either by routine practices following fixed rules or instructions (example: accountant) or by discretionary or managerial decision making. The interpreter has to use his or her imagination to create in a new form effects equivalent to those intended by the message received (example: translator of poetry in a foreign language). The analyzer uses much of his or her own judgment and intuition besides accepted procedures, so that what he or she transmits is quite different from the message received. The original creator, though drawing on a rich store of information received in the past, adds so much personal inventive genious and creative imagination that only weak and indirect connections can be found between what he or she has received and what he or she communicates.

8. Statistics of Knowledge Occupations

To permit numerical estimates of the numbers of persons in these eight classes or levels, very detailed statistical information is required. American census data permit the sorting from broader categories the occupations engaged chiefly in knowledge production. Thus, after eliminating all occupations that include a large component of manual work, the percentage breakdown given in Table 2 was found for the civilian labor force in the United States in 1960 and in 1970.

Table 2
Percentage of the total civilian labor force in knowledge occupations in the United States

	1960	1970
Professional and technical workers in nonmanual work	9.0	11.8
Managers, officials, and proprietors (excluding farm)	5.8	6.5
Clerical workers	14.9	17.9
Sales workers in nonmanual work	3.1	3.2
Craftsmen and foremen in nonmanual work	0.5	0.5
Total in nonmanual work	33.3	39.9
Occupations not producing knowledge	66.7	60.1

In interpreting these percentages one must bear in mind that several of the first five categories in the official statistics contain occupations which we have transferred into the class of occupations not producing knowledge. For example, we have so transferred certain groups of professional and technical workers such as dentists and pharmacists, proprietors of small shops, more than one-half of sales workers, and almost all (97 percent) of the craftsmen and foremen. This explains why the statistics of white-collar labor in the United States come to larger percentages than those shown here for knowledge-producing workers. However, considerably higher percentages of knowledge workers are obtained if one includes students from the ninth grade upward, and hence of employable age, among the knowledge occupations and among the potential labor force: the percentages of persons producing knowledge (including knowledge in their own minds) were 44.3 percent in 1960 and 53.1 percent in 1970.

The Organisation for Economic Co-operation and Development (OECD) supplied estimates of the "information labor force" as a percentage of the total labor force in nine industrial countries, but not for the same year. The percentage for 1970 or 1971 was 41.1 in the United States, 39.9 in Canada, 35.6 in the United Kingdom, and 28.0 in Austria; for 1975 (evidently higher than 4 or 5 years earlier) it was 34.9 in Sweden, 32.1 in France, 29.6 in Japan, and 27.5 in Finland. The OECD also estimated the shares of "information producers," "information processors," "information distributors," and "information infrastructure operators." Educators are regarded as information distributors. The lack of linguistic sensitiveness in characterizing education as intending to distribute information instead of to develop cognitive and artistic skills and to implant knowledge of enduring value is regrettable.

9. *Growth of Knowledge Industries and of Knowledge Occupations*

The rates of growth observed in knowledge industries have exceeded those of the GNP, and the rates of growth observed in knowledge occupations have exceeded those of the total labor force. This was true for both Japan and the United States—at least until 1970—and probably also for other developed countries.

The highest growth rates are always found in new industries. Thus, in the 4 years from 1954 to 1958 American sales of electronic computers increased at a compounded rate of 104.4 percent per year. Similarly, in the 11 years from 1947 to 1958 the revenues of American television stations increased at a compounded rate of 77.2 percent per year. These growth rates are typical of all new industries, not just of knowledge industries. But the growth of all knowledge industries together was fast enough to suggest a trend. In the United States, the weighted average of the annual rates of increase of 36 branches of the knowledge industry for which data covering a period of 11 years ending in 1958 were available was 10.6 percent, which compares with a 5.9 percent rate of increase of GNP at current prices and with a 4.1 percent rate of increase of goods and services other than those produced by the knowledge industry.

A detailed breakdown of growth rates for various classes of knowledge industries in Japan shows that in the 5 years from 1960 to 1965 expenditures for education increased at a compound annual rate of 19.5 percent, research and development at 18.4 percent; free professions at 24.8 percent; "package knowledge" at 17.2 percent; and telecommunications at 14.7 percent. The weighted average of these growth rates was 18.1 percent, which may be compared with the annual growth rate of Japan's GNP (at current prices) of 14.8 percent. Again, the knowledge output increased faster than the total output of the nation.

The growth in the number of persons in knowledge occupations can be observed over a much longer period, at least in the United States. The percentage of workers in knowledge occupations increased from 10.7 percent of the labor force in 1900 to 18.3 percent in 1920, 23.4 percent in 1940, to 33.6 percent in 1960, and to 39.9 percent in 1970. The percentage of workers plus students of employable age increased from 13.5 percent of the potential labor force in 1900 to 23.9 percent in 1920, to 34.4 percent in 1940, to 44.3 percent in 1960, and to 5[illegible] percent in 1970. But not only did the ratio of mental to manual workers increase so sharply, but within the categories of knowledge occupations one can observe a trend from lower level to higher level knowledge work. Looking over a span of 70 years, from 1900 to 1970, clerical workers showed the largest percentage increase; during an intermediate period of 20 years from 1940 to 1960 the group of managers and officials had the largest increase; but over the period from 1940 to 1970 the professional and technical workers increased fastest.

Similar developments can be seen in Japan, though the statistical data go back only to 1952. Taking all professional and technical workers, all managers, officials, and proprietors (excluding farm proprietors), all clerical workers, and half of the sales workers, we find that their share in the total labor force increased from 20.1 percent in 1952 to 27.0 percent in 1965, and to 29.1 percent in 1969. These changes in the composition of the labor force in Japan are due to differences in the rates of growth of the various categories of work. Clerical workers were the fastest growing group in Japan over the 17 years from 1952 to 1969, when its compounded annual growth rate was 4.8 percent, but no longer over the 9 years from 1960 to 1969, when its annual growth rate was down to 4.5 percent and the category of managers and officials had reached a growth rate of 5.3 percent. Over these two periods the total labor force increased only by 1.8 percent and 1.3 percent, respectively.

10. *The Outlook for the Future*

Projections into the future can be misleading. Many economists expect that the knowledge industries will for some years continue to grow faster than the economy as a whole. Some are convinced that many of those alive today may in their lifetime see society devote more than 50 percent of its total measured economic activity to the production of knowledge. Among the branches of knowledge industries that social reformers wish to grow especially fast is education.

At least three reasons have been given to support the view that the growth of the production of knowledge will continue for some time at a rate faster than that of the economy as a whole. Firstly, knowledge production increases productivity; individuals, business firms, and governments recognize it as an investment yielding a high rate of return. Secondly, partly as a result of these investments, technology changes from processes using much physical labor to processes using more mental labor; thus knowledge is an increasingly productive intermediate product in many industries, and productivity increases most rapidly where the ratio of what Adam Smith and Karl Marx used to call "productive labor" declines relative to what they called "unproductive labor." Thirdly, the demand for knowledge as a consumer good, for entertainment or for the enrichment of our lives, has been increasing at a fast rate; this demand may continue to rise more than proportionally with the consumers' incomes.

At the same time there will be a steady increase in the educational levels attained by the people. This permits a constant upgrading in the occupational composition of the labor force. With both the supply of knowledge input and the demand for knowledge output rising, the trend may continue for some time; one should

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not be surprised, however, if the proportion devoted to knowledge production levels off before long.

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Human Capital Concepts

M. Woodhall

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The concept of human capital refers to the fact that human beings invest in themselves, by means of education, training, or other activities, which raises their future income by increasing their lifetime earnings. Economists use the term "investment" to refer to expenditure on assets which will produce income in the future, and contrast investment expenditure with consumption, which produces immediate satisfaction or benefits, but does not create future income. Assets which will generate income in the future are called capital. Traditionally, economic analysis of investment and capital tended to concentrate on physical capital, namely machinery, equipment, or buildings, which would generate income in the future by creating productive capacity. However, a number of classical economists, notably Adam Smith, pointed out that education helped to increase the productive capacity of workers, in the same way as the purchase of new machinery, or other forms of physical capital, increased the productive capacity of a factory or other enterprise. Thus, an analogy was drawn between investment in physical capital and investment in human capital.

The concept was not fully developed, however, until the early 1960s when the American economist Theodore Schultz analysed educational expenditure as a form of investment (Schultz 1961), the *Journal of Political Economy* in the United States published a supplement on "Investment in Human Beings" in 1962, and Gary Becker published a book with the title *Human Capital* (Becker 1964, 2nd edn. 1975) which developed a theory of human capital formation and analysed the rate of return to investment in education and training.

Since that time the concept of human capital has dominated the economics of education and has had a powerful influence on the analysis of labour markets, wage determination, and other branches of economics, such as the analysis of economic growth, as well as expenditure on health care and the study of migration. For it is recognized that these also represent investment in human capital, since they can help to determine the earning capacity of individuals, and therefore increase their lifetime incomes.

However, investment in human capital remains a controversial issue. Attempts to measure the rate of return to investment in education have been attacked by critics who argue that education does not increase the productive capacity of workers but simply acts as a "screening device" which enables employers to identify individuals with higher innate ability or personal characteristics which make them more productive. A summary of this controversy is given below, together with a brief review of research on investment in education and some other applications of the concept of human capital. However, more detailed treatment of all these issues is provided in separate entries.

1. *Measuring the Rate of Return to Investment in Human Capital*

When economists refer to expenditure on education and training as investment in human capital, they are doing more than pointing to analogies between education and investment in physical capital. They are asserting that it is possible to measure the profitability of investment in human capital using the same techniques of cost–benefit analysis and investment appraisal that have been traditionally applied to physical capital.

The profitability, or rate of return on investment, is a measure of the expected yield of the investment, in terms of the future benefits, or income stream generated by the capital, compared with the cost of acquiring the capital asset. Cost–benefit analysis is designed to express all the costs and benefits associated with an investment project in terms of a single figure, the rate of return, which shows the rate of interest at which the present discounted value of future income is exactly equal to the present discounted value of costs. This enables different projects to be compared and an optimum investment strategy consists of identifying and investing in projects offering the highest rate of return, or profitability.

If money devoted to education, training, or health care is regarded as investment in human capital, since it raises the lifetime earnings of workers who are better

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educated and trained or more healthy than other workers, then techniques of cost–benefit analysis can be used to compare the economic profitability of different types or levels of education, of on-the-job compared with off-the-job training, or of different types of medical treatment. It should also be possible to compare rates of return to investment in human capital and physical capital, in order to discover whether it is more profitable to invest in men and women or machines.

Investment in human capital produces benefits both to the individual and to society as a whole. The individual who takes part in education or vocational training benefits by increasing his or her chances of employment and by increased lifetime earnings. These additional earnings, after allowance for payment of taxes, can be compared with the direct and indirect costs of education that must be borne by the individual, including fees, expenditure on books or equipment, and earnings forgone while in school, college, or university. This provides a measure of the private rate of return to investment in education or other form of human capital.

Both the costs and benefits of education also affect society as a whole, since society benefits from the increased productivity of educated workers. Throughout the world this is recognized by governments who pay some or all of the costs of education, and provide free or subsidized tuition in schools or higher education institutions. The costs and benefits to society can be compared by means of the social rate of return.

The question of the profitability of different types and levels of education and training, and the question of the relative yield of investment in human capital and physical capital have attracted a considerable amount of research activity since the 1960s, as well as provoking fierce disagreements among economists and educational planners. Psacharopoulos has reviewed attempts to measure the social and private rate of return to investment in education in 32 countries (Psacharopoulos 1973) and more recently has updated this survey of research on the returns to education by analysing the results of cost–benefit analysis of education in 44 countries (Psacharopoulos 1981). Estimates of social and private rates of return to educational investment, based on surveys of the earnings of workers of different educational levels in 44 countries in the period from 1958 to 1978 reveal, according to Psacharopoulos (1981 p. 326), four underlying patterns:

(a) The returns to primary education (whether social or private) are the highest among all educational levels.

(b) Private returns are in excess of social returns, especially at the university level.

(c) All rates of return to investment in education are well above the 10 percent common yardstick of the opportunity cost of capital.

(d) The returns to education in less developed countries are higher relative to the corresponding returns in more advanced countries.

2. *The Profitability of Human Capital Versus Physical Capital*

The rates of return that are reviewed by Psacharopoulos are summarized in Table 1, which shows the average private and social rate of return for primary, secondary, intermediate, and higher education in less developed, intermediate, and economically advanced countries. These rate of return estimates refer to single years, and therefore do not show how rates of return change over time, although the average rate of return is calculated from estimates for years which range over a 20-year period. However, there are very few countries for which it is possible to calculate rates of return on an historical time-series basis. Data exist on earnings of workers in the United States classified by educational level since 1939. Estimates of rates of return to secondary and higher education between 1939 and 1976 suggest that the returns to education are falling, although not by a large amount. Data from Colombia also suggest that between 1963 and 1974 the returns to education declined, but still remained profitable.

Table 1
The returns to education by region and country type (%)[a]

Region or country type	N[c]	Private Prim.[d]	Private Sec.[e]	Private High.[f]	Social Prim.	Social Sec.	Social High.
Africa	(9)	29	22	32	29	17	12
Asia	(8)	32	17	19	16	12	11
Latin America	(5)	24	20	23	44	17	18
LDC average	(22)	29	19	24	27	16	13
Intermediate	(8)	20	17	17	16	14	10
Advanced	(14)	(b)	14	12	(a)	10	9

a Source: Psacharopoulos (1973 p. 86) b Not computable because of lack of a control group of illiterates c N = Number of countries in each group d Prim. = primary educational level e Sec. = secondary educational level f High. = higher educational level

Table 2
The returns to alternative forms of capital by level of economic development[a]

Level of development	Physical capital		Human capital
Per capita income under $1,000 (7 countries)	15.1	<	19.9
Per capita income over $1,000 (6 countries)	10.5	>	8.3

a Source: Psacharopoulos (1981 p. 329)

The results of all these studies confirm that expenditure on education does represent investment in human capital, and that it is a profitable investment, both for the individual and for society, although some critics deny that the earnings of educated workers provide an adequate measure of the economic benefits of education. It is difficult, however, to answer the question of whether human or physical capital represents the more profitable form of investment.

An early attempt to answer this question was called "Investment in Men versus Investment in Machines?" (Harberger 1965), and this is still a question that is of vital concern to economists and planners. Psacharopoulos examined estimates of the returns to physical capital in both developed and developing countries and concluded: (a) the returns to both forms of capital are higher in developing countries, which reflects the differences in relative scarcities of capital in either form in developed and developing countries; and (b) human capital is a superior investment in developing countries but not in developed countries, as indicated by the reversal of the inequality signs in Table 2 (Psacharopoulos 1973 p. 86).

3. *How Does Human Capital Increase Workers' Productivity?*

The earliest explanations of the concept of human capital suggested that education or training raised the productivity of workers, and hence increased their lifetime earnings, by imparting useful knowledge and skills. However, this assumption was soon attacked by critics who argued that the higher earnings of educated workers simply reflected their superior ability, rather than the specific knowledge and skills acquired during the educational process. In addition, it was argued that highly educated workers are more likely to come from higher social class groups in society, and to work in urban rather than rural areas. Many estimates of rates of return to education therefore adjust the observed earnings differentials of educated people to allow for the influence of other factors on earnings.

Since ability is one of the main factors that may determine earnings, this is often called the "ability adjustment" or alternatively the "alpha coefficient", where "alpha" (α) represents the proportion of the extra earnings of the educated, which is assumed to be due to education. Regression analysis and earnings functions suggest that an appropriate value for the α coefficient is between 0.66 and 0.8 (Psacharopoulos 1975). Further details of research on this problem, together with an explanation of earnings functions, will be found in separate entries.

More recently, however, critics have gone further, and have argued that education does not improve productivity by imparting necessary knowledge and skills, but simply acts as a screening device, which enables employers to identify individuals who possess either superior innate ability or certain personal characteristics, such as attitudes towards authority, punctuality, or motivation, which employers value and which are therefore rewarded by means of higher earnings.

This argument is called by various names in the literature, including the "screening" or "filtering" hypothesis, or alternatively the "certification" or "sheepskin" argument, since it is suggested that education simply confers a certificate, diploma, or "sheepskin", which enables the holder to obtain a well-paid job without directly affecting his or her productivity. This argument has attracted considerable controversy, but has been refuted by a number of economists who argue that while a "weak" version of the screening hypothesis is undoubtedly true, since employers do use educational qualifications in selecting employees, as a proxy for other characteristics, there is no evidence to support the "strong" versions of the hypothesis, that education has no direct effect on productivity. The fact that employers continue to pay educated workers more than uneducated throughout their working lives refutes this (Psacharopoulos 1979).

Even if the "strong" version of the screening hypothesis is rejected, and it is difficult to see why no cheaper means of identifying workers with desired characteristics has not been developed if education really had no effect on productivity, it is nevertheless true that the idea of education as a screen or filter has been important in influencing recent directions in research in the economics of education, Blaug (1976) in a review of research on investment in human capital, which he describes as a "slightly jaundiced survey" of the empirical status of human capital theory, predicts that

> in time, the screening hypothesis will be seen to have marked a turning point in the "human investment revolution in economic thought", a turning point to a richer, still more comprehensive view of the sequential life cycle choices of individuals. (Blaug 1976 p. 850)

✓ The reason why the screening hypothesis is important is that it has focused attention on the precise way in which education or other forms of investment in human capital influence productivity, and has served as a reminder that education does far more than impart knowledge and skills. The reason why employers continue to prefer educated workers is that not only does the possession of an educational qualification indicate that an individual has certain abilities, aptitudes, and attitudes, but the educational process helps to shape and develop those attributes. In other words, it is now increasingly recognized that education affects attitudes, motivation, and other personal characteristics, as well as providing knowledge and skills.

This means that the concept of investment in human capital is still valid, but it must be extended to include activities which affect personal attributes as well as skills, and it must recognize that such activities increase workers' productivity in complex ways.

4. *Other Forms of Investment in Human Capital*

Other forms of investment in human capital also develop the personal attributes that help to determine a worker's productivity. On-the-job training and work experience and the process of job search, including migration, as well as health care, can all increase earning capacity, and can therefore be regarded as investment in human capital. Blaug's survey of research on human capital links all these activities together.

> The concept of human capital, or "hard core" of the human-capital research program is the idea that people spend on themselves in diverse ways, not for the sake of present enjoyments, but for the sake of future pecuniary and non pecuniary returns . . . . All these phenomena—health, education, job search, information retrieval, migration and in-service training—may be viewed as investment rather than consumption, whether undertaken by individuals on their own behalf or undertaken by society on behalf of its members. What knits these phenomena together is not the question of who undertakes what, but rather the fact that the decision maker, whoever he is, looks forward to the future for the justification of his present actions . . . . The human capital research program has moved steadily away from some of its early naive formulations . . . (but) it has never entirely lost sight of its original goal of demonstrating that a whole range of apparently disconnected phenomena in the world are the outcome of a definite pattern of individual decisions having in common the features of forgoing present gains for the prospect of future ones. (Blaug 1976 pp. 829, 850)

Not only does research in human capital now link those apparently disparate activities together, but many programmes that have been developed in recent years in response to high levels of unemployment among young people are increasingly concerned to forge closer links between education, training, and work experience. Programmes such as the Youth Opportunities Programme and Youth Training Scheme in the United Kingdom and a number of programmes for young people in Europe are designed to provide alternating periods of vocational education, training, and work experience, recognizing that all these activities represent investment in human capital (CEDEFOP 1982).

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On-the-job Training

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The term "on-the-job training" is used in several overlapping ways, all of which are usually focused on postschool learning. The first section of this entry discusses briefly the scope and variations in what is often included with on-the-job training in the descriptive and nontechnical literature. The second and third sections deal with the meanings and treatments of on-the-job training in human capital investment theory and its applications. Attention is then turned in the fourth section to a well-known view of institutional adaptations associated with on-the-job training in a dynamic context, characterizing some of the work on what has come to be labeled "internal labor markets" (internal, that is, to a particular firm or agency). Finally, the largely unseen informal economy is noted along with the training and learning activities that go on in its many crannies.

1. *On-the-job Training in Nontechnical Usage*

At one extreme, the label on-the-job training is used quite literally to refer to organized instruction in the work place. Somewhat less narrowly (and more often) the scope of what is included covers job-related training sponsored by the employer or required as a condition of promotion even when conducted on other premises and whether any direct outlays are covered by the individual or by the employer.

Remarkably little attention is given in most such discussions to the many variants of apprenticeship and its modifications over time with changes in economic structures. Nevertheless, apprenticeship training in great variety and with all degrees of formalization is of critical importance today in both the less and the more developed countries. It is important not only for the more traditional manual skills but for other skills as well; indeed, most Ph.D. recipients have absorbed large amounts of apprentice training in the process of acquiring research competence. Apprenticeship clearly constitutes a form (or set of forms) of on-the-job training even in a relatively narrow definition of that term; this is normally recognized where apprentice programs are developed as part of an organized government policy, but it is often ignored when apprenticeship arrangements evolve spontaneously and remain relatively informal in their structure. These biases in what comes to be included have had counterparts in analyses of labor markets and of human resource development. Fortunately, this fact is coming to be more adequately recognized in some of the less developed countries (LDCs).

Meanwhile, increasing alertness has emerged among both planners and researchers to the fact that time in school and time in the labor force need not be, and often are not, separated by a sharp divide. The long-established German system of extended part-time vocational education for youth in their first jobs is a striking example. If the vocational training is related to the jobs held and promotions in them this is unambiguously a variant of on-the-job training. A quite different but equally interesting type of arrangement is exemplified by *Servicio Nacional de Aprendizaje* (SENA) in Colombia and the complex of related programs in Brazil, with some but not all of the students individually sponsored by firms that will employ them later or may be employing them at intervals during the training program. Sandwich courses at polytechnic levels have a long history in the United Kingdom that has been carried over in some cases to new states. The list is easily extended.

Yet another step toward generalization of what is counted as on-the-job training is the inclusion of much of the wide range of activities encompassed in what has sometimes been called "nonformal education" (public or private) and in the vogue for "recurrent education" led by Sweden and evoking varying responses since about 1970 elsewhere. Much of this type of training is indistinguishable in practice from activities commonly labeled on-the-job, though often it might be more accurately termed "out-of-a-job training in hope of a job."

The common element that brings together a diverse array of activities under a broadly defined label on-the-job training is not, in fact, whether the training is received by an individual virtually as part of the job (whether in the work place or elsewhere). Rather, what seems to be common to all cases is training of active members of the labor force with the purpose of improving career prospects. There are costs involved in such training, however those costs may be shared. On-the-job training entails investments in the human capital of men and women who have already joined the labor force, and these investments are oriented toward their futures in paid or (less often) in independent employment.

2. *Opportunity Costs and On-the-job Training*

Studies of schooling as an investment as they were conducted in earlier years and are often conducted today constitute only one element in human capital theory. A seminal contribution to that theory came with Becker's incorporation of investments in human beings on through the postschool years in an integrated theory with investments in schooling (Becker 1962, 1975). There were two essential elements in Becker's formulation. First was the application of an old and powerful concept that is at the heart of economic theory, the concept of opportunity cost, to the costs of spending time in school or training—commonly referred to in the human capital literature as forgone earnings. Second was the analytical distinction between general and specific training of human capital. While opportunity costs are entailed in both sorts of human capital formation, the most direct applications in empirical work on earning streams deal only with the general (portable) components of learning and earning in the school years and in later years. Though presented initially in terms of time diverted from earning to learning, subsequently analysis was expressed in "time-equivalent units" and emphasis shifted to the importance of experience as an indicator of potentials for on-the-job training. Earnings are forgone when a person takes a job on which he or she will receive lower immediate pay but a compensating increase in the value of his (less often her) portable human capital; the forgone earnings are the individual's investment in acquisition of that human capital. It does not matter, at this level of analysis, whether the accumulation of human capital occurs through formal instructional programs or in the most informal ways through cumulative experience on a job in which one learns by doing. There may very well be a mixture of both elements of learning, as there has always been in apprenticeship for the skilled crafts and as there is, in fact, in much white-collar employment. In any case, estimates of the extent of investment through forgone earnings were designated on-the-job training in the first empirical forays by Mincer (1962), a designation that has carried over into much subsequent work.

The initial formulations, along with most of the theoretical and empirical models that followed in the later 1960s and the 1970s, viewed the investments individuals make in themselves as outcomes of a sequence of decisions made implicitly or explicitly at frequent intervals.

Along with the further simplifying assumption that marginal rates of return to schooling and to postschool investments were equal, this way of formulating the process allowed researchers to estimate the time path of investments and returns over a man's life. (Analysis for women, incorporating periods out of the labor force, came later.) There have been experiments that dispense with the assumptions of the equality of marginal rates of return to schooling and to postschool investments, and skill obsolescence has been brought into the picture. The initial and simplest model remains at the core of these refinements, however, and it must suffice here.

It is possible using the Mincer approach in its initial form to separate out the schooling and on-the-job training components of earning streams (Mincer 1962, 1974, Bowman 1968, 1974). Let us suppose that we have matched two male populations as far as socioeconomic background, health, native ability, and so forth are concerned, but that one of these populations has completed the ith level of schooling whereas the other has completed schooling $i+m$. We wish to compare the schooling and on-the-job training components accounting for the differences in the average earning streams of these two populations. In analyzing this problem we may set up two highly simplified models.

2.1 Model 1

Earning differentials match differences in productivity, they are determined solely by differences in schooling, those earning differentials are realized immediately, and productive capacity is maintained intact until its complete demise. Designating the cost of schooling increment m as C_m and the rate of return on that investment as r_m, the incremental earning path will be unchanging at the value r_mC_m. Starting from an earning path for no schooling and adding to those earnings incrementally for each increment of schooling would give the earning path for a person with schooling $i+m$. Taking $(i+m)=j$ gives the line labeled Y_j^* in Fig. 1 for earnings over the period from $t=0$ to $t=T$, when earnings cease.

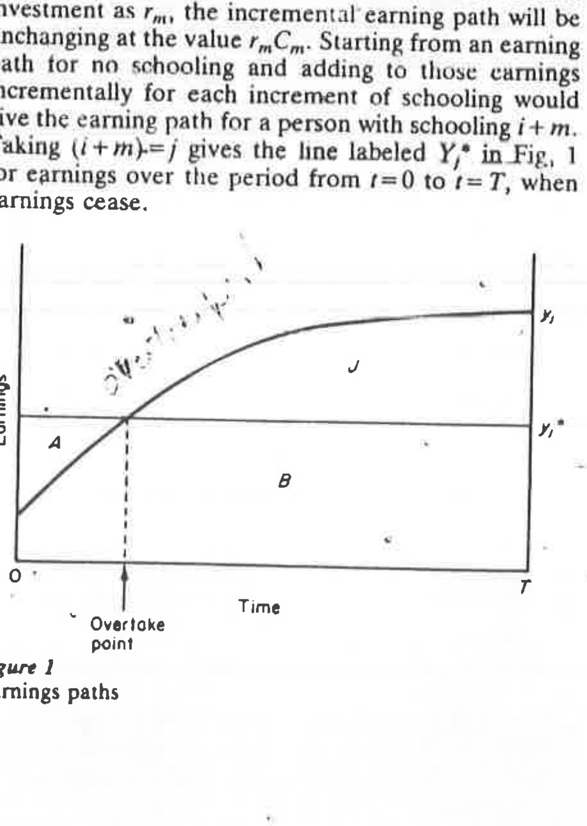

Figure 1
Earnings paths

2.2 Model 2

The potential productivity differentials determined by schooling are the same as in Model 1, taking effect immediately and being sustained intact throughout working life. In addition, however, there are opportunity-cost investments in on-the-job learning, which account for the concavity of observed earning streams. The internal rate of return to an increment of schooling m and rates of return to associated postschool investments are equal. The curve Y_j, which includes effects of investments in the postschool accumulation of human capital, intersects Y_j^* from below because of the forgone earnings in the early years. The point of intersection is known in economics following Mincer (1974) as the "overtake point," at which observed earnings (which are net of opportunity-cost investments in oneself) come to match and then to surpass the returns to schooling when there is no on-the-job training. If we maintain the assumptions of Model 2, which are Mincer's assumptions (Mincer 1962, 1974), the area $(J-A)$ is the undiscounted aggregate net return to investments of the individual in on-the-job learning or training. The area $(A+B)$ is the undiscounted gross return to the investment in schooling, and the net contribution of schooling is $(A+B-C)$. The undiscounted total net contribution of investments in schooling and on-the-job training is thus $(B+J-C)$ and the postschool proportion of this total is $(J-A)/(B+J-C)$ (see Fig. 1).

Model 2 is a powerful simplification and the ratio $(J-A)/(B+J)$ with or without a correction for C can be a useful descriptive statistic even when the assumptions of the model are challenged. Challenges must arise in any careful consideration of empirical findings using age cross-section data in any case. Other problems of specification aside, each observation of people of a given age at a given calendar date is an observation referring to members of a particular and hence necessarily unique cohort.

3. The Concept of "General" Training and the Individual as the Investor in Training on the Job

The models laid out thus far refer only to that part of on-the-job training that is implicitly financed and returns on which are received by the individual. The share of investment costs borne and the returns received by a firm or employing agency will not show up in the individual's earning stream. In the terminology of human-capital theory, only "general" human capital is picked up in the above formulation. "Firm-specific" human capital is not.

There are two main overlapping concepts of general training or learning. The first of these, which may be designated general I training simply for convenience here, refers to the acquisition of capabilities or traits that have value over a wide range of uses and activities. The most general of all training is in literacy and numeracy, usually acquired in elementary schools. Most fundamental in general training is learning to learn. Persons with a foundation in the most general capabilities will be more readily trainable in many more specialized skills. By the same token, such training is the foundation of capabilities to communicate effectively, to seek out and interpret information, and to adjust to changing situations and opportunities. What is often regarded as specialized training may be classified as general I, however, in that it may serve over a wide range of uses and in diverse settings: carpentry and clerical skills are examples. Indeed, such skills may be far more general in their applications than the supposedly "general" education of the traditional elites of Oxford or Cambridge universities who used to man the British foreign service.

What might be designated here as general II training is the concept associated with human capital theory. General human capital (in contrast to specific human capital) is portable. In other words, the general human capital embodied in a person can be applied in agencies other than that in which the capabilities were acquired. General I training is necessarily also portable, but portability does not necessarily imply general I training or capabilities. A doctor may have been trained in a highly specialized skill, as open heart surgery; this is hardly a general I sort of skill, but the heart surgeon is not limited to practice in the hospital in which he or she received his or her training. The skills embodied in the heart surgeon are portable, and hence in this sense general. So are the skills of a cook or a barber (or, in most industrialized economies, semiskilled operatives in textile factories), however specialized these skills may be.

General skills defined in terms of portability have a central place in the treatment of learning in school and at work as parts of an integrated theory of human capital, first refined by Becker (1962) and applied empirically by Mincer (1958, 1962, 1974), in the interpretation of the concave shapes of earning paths over a man's (and in lesser degree a woman's) life.

Let us consider first the employer who is providing the training. If this employer paid the trainee full-time wages without regard to the time taken out for learning and the direct costs of the instruction, but the trainee then went on to another employer, carrying the full value of his newly acquired human capital with him, the first employer would get no return on his investment in training. Indeed, he would not make that investment unless he could shift the costs onto the trainee. What happens in the extreme case of completely general formation of human capital is then a shift of the investment cost to the trainee in the form of partially foregone earnings. In effect, the employer sells and the employee buys the increments to the individual's portable human capital.

An essential element in this theoretical construct is the concept of opportunity costs, or "forgone earnings," whether in attending school or later on. Thus the individual may take a job that yields only small earnings at first if by doing so he or she can build up general human capital from which greater returns can be expected later on. The difference between current earnings in this job and what could be earned initially in a dead-end job is the opportunity cost incurred as an investment by the individual in the acquisition of human capital. (Forgone earnings when attending school is simply a special case of opportunity-cost investments in oneself.) Readiness to bear the full opportunity costs of earnings forgone in school or at work depends on the extent to which the individual can carry the compensating accumulation of human capital elsewhere—that is, on the portability of the skills acquired. It follows from this view of labor markets that the steeper the gradient of earnings and the lower the associated initial earnings, the greater must be the postschool investments that people are making in themselves. Or such is the case so long as the human capital is fully portable.

To the extent to which the accumulation of human capital in an employee is specific to the firm (nonportable) the situation is changed. While earning paths may still provide rough clues to costs borne by individuals and returns on those investments, they cannot capture that part of the costs of on-the-job training that is ultimately borne by the employer, or the employer's share in the rewards.

4. *Firm-specific Training and the Sharing of Costs and Returns*

As the term "specific training" has been used in human capital theory since Becker's seminal work (1962, 1975), it has the precise meaning of nonportability. This is not the same thing as specialized training, which may or may not be portable. Rarely does anyone acquire specific human capital without at the same time acquiring at least some additions to his or her general human capital. A secretary, for example, may be of greater value as he or she comes to know the informal communication networks in which the boss participates. More generally, productivity in an enterprise depends not only on the aggregate of capabilities of individuals taken separately, but also on the development of effective interaction patterns and team work; an individual who has become integrated into joint activities and ways of doing things has acquired specific human capital that makes him or her more valuable than a new recruit to the enterprise, but that human capital cannot be carried elsewhere.

Both the firm and the individual have a stake in the accumulation of specific human capital, and the result spelled out in human capital theory is a sharing of the costs of and returns to the formation of such capabilities. Other things being equal, a large admixture of firm-specific relative to general (portable) human capital would be reflected in flatter life-earning paths than where the proportion of portable human capital is higher. Other things are rarely equal, however.

5. *Firm-specific Human Capital and Labor Market Structures*

It is not enough to look at on-the-job training from the perspective of either individuals or firms as investors in some given institutional context, for institutions themselves both affect and are affected by the processes of human resource development. We are dealing with multiple endogenous variables. For one thing, there is usually a much greater investment in the firm-specific skills of men than of women; flatter age–earning curves will be observed in enterprises that hire relatively many women even though these enterprises are likely also to be characterized by little firm-specific human capital. Even considering men only, arrangements that foster the development of firm-specific human capital are often in turn fostered by the enlargement of such capital as a substantial component in the assets of both the firm and its individual personnel. Such arrangements include management practices and personnel policies that discourage turnover of a firm's labor force through quits and layoffs alike. Both the costs of and the returns to investments in human resource formation at work are shared by employers and employees, since both have an interest in stabilizing the association. As Oi showed many years ago (1962), labor then becomes a "quasi-fixed factor of production."

The relative importance of firm-specific human capital (and hence of the formal or informal training through which such capital is acquired) depends in part on the size of an economy. In a small country in which there is only one textile mill, for example, skills learned by operators in that mill may be specific to it so long as there are substantial barriers (formal, cultural, or linguistic) to international migration. But this illustrates also the fact that what makes a skill specific may often depend as much on institutional constraints on mobility as on the nature of a skill (Bowman 1965). The development of customs that have constrained mobility between firms in Japan are frequently cited in discussions of specific human capital. The degree of uniqueness of the Japanese situation and of its limitations on interfirm mobility are often exaggerated, however, even as analogous situations elsewhere are ignored. Moreover, substantial investments in firm-specific human capital do not mean a lack of flexibility in the development and allocation of human resources where internal labor markets are large and well-developed.

Stability in attachments between firms and their employees and the formation of firm-specific human capital are mutually supportive features of labor markets, both "external" and "internal," but most obviously and directly of internal labor markets. This means, among other things, an extension of time horizons in the formal or implicit terms of contracts between employer and employee. The longer those horizons the greater is the scope for variations in trade-offs over time. Investments in and returns to on-the-job training can come to be confounded in earnings data by arrangements that constitute in part an internal capital as well as an internal labor market, the internal capital market performing a hidden function of lending and borrowing between firm and employee that is adapted in part to the economic life cycles of consumption and earnings. This phenomenon is especially important for interpretations of the workings of Japanese internal labor markets as agencies of human resource development. Those markets often differ substantially from internal labor markets in other countries with strong seniority provisions but with quite different management–labor relations and sources of the seniority arrangements. The importance of on-the-job training in Japanese firms will be questioned by no-one familiar with management and personnel policies in that country.

In sum, when human capital theory is applied to analysis of rational behavior of firms as well as of individuals in a world in which training and human capital are a mixture of the general and the specific, the importance of associations between on-the-job training and long-term commitments is underlined. Rough measurement by methods applicable to general training may still have its uses, but some of the elegant optimal control models run into severe problems. One direction that further work has taken has been a shift toward greater emphasis on the new economics of information and the "matching" of firms and employers in search processes. This has reduced somewhat the attention given to investments by either individuals or firms in on-the-job training, but without challenging the earlier work. Meanwhile research on life cycle earnings and learning at work has been enriched by studies of the labor force participation of women and effects of interruptions in the continuity of their employment on subsequent life-earning prospects.

6. *On-the-job Training and Institutional Adaptation to Change*

The term "internal labor markets" is entirely appropriate to analysis of adjustments by firm and individual in human capital theory. That term is more often used in other contexts, however, and it has spread rapidly since about 1970. In so doing, it has taken on at least as many variants as on-the-job training, especially in the sociological literature, as is amply demonstrated in Berg (1981). Of greatest interest here, however, must be the line of thought stimulated by Doeringer and Piore (1966). The focus in this and in related subsequent work is on how economic institutions adapt to provide education and training for adults in skills that come into being and are increasingly demanded by innovative change in a dynamic economy. In some respects the work by Doeringer and Piore stands at the opposite extreme from the optimal control models stimulated by human capital theory. It gives far more explicit attention to economic change and far less to life cycle experiences. It provides good descriptive analyses of some of the institutional options in adjustment to and furtherance of innovative change at a level that work of some of their followers have been less productive than they might have been. Furthermore, even the descriptive work suffers from the lack of a comparative perspective—a deficiency that is being amply overcome for the advanced countries with the recent flood of research on internal labor markets in large enterprises in Japan.

It is often supposed that this line of work runs counter to human capital theories. Perhaps, however, this is instead a case of potential complementarity of endeavor, but with insufficient communication among economists who have started from different initial perspectives. After the investigation of internal labor markets that he and Doeringer had conducted for the United States Department of Labor, Piore wrote:

> . . . the training process yields one explanation for the rigidity of internal wage structure and the use of seniority to govern promotion and lay-off. Without the protection which these provide, experienced workers would be reluctant to cooperate in training, for fear that the competition of newly trained workers would undermine income and job security. (Piore 1968 p. 439)

This conclusion points to relationships ignored in most of the human capital literature. At the same time, it bypasses completely the whole question of what part managements and personnel policies may play in the creation and modification of incentive structures in the work force, along with related questions about the nature of labor unions and contrasts in their histories and modes of operation in different countries (and even within a single country). It bypasses also, perhaps for the same reasons, the question of what may be the incentives to workers and to employers to invest in the formation of human capital. One result has been a failure in most of the literature on internal labor markets to probe more deeply into the ways in which costs of labor turnover (quits as well as layoffs) and investments in on-the-job training may be affected by and may affect other aspects of institutional structures and behavior. To the extent that economists have approached these questions they have worked primarily from a combination of human capital theory and search theory.

7. On-the-job Training in the Invisible Economy

That on-the-job training, however defined, is of crucial importance not only for economic growth but for the sustained viability of an economy in the modern world is hardly open to question. What, if anything, governments could or should do about it is a matter of hot debate in both industrially advanced countries and LDCs. What has been most often neglected, meanwhile, is consideration of the training and learning that takes place in the less visible sectors of the economy. This neglect characterizes even the research on Japan, despite the proliferation of painstaking studies of labor efficiency in larger firms in that country. Most serious, however, has been a propensity to ignore the importance of learning systems that have evolved informally in many of the LDCs when public policy has given scope for the exercise of ingenuity in the unseen eddies of economic life. Such training and learning tends to elude conventional quantitative counts. It is part of what goes into determination of age–earning streams, but no analysis at the level of aggregation that has characterized empirical estimates in the human capital tradition will illuminate these facets of the life of a people. A few sallies into this large but largely unexplored territory have shown that it may be much richer than commonly has been supposed. Work by King (1975a) on Kenya is an illuminating example, but the Kenyan government has not penalized initiative in the informal sectors of the economy as have some of the LDCs. No-one knows how much on-the-job training goes on in the less developed countries, or to what extent such activities are inadvertently discouraged (or encouraged) by public policies.

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PART II

Educational Production

Educational Production Functions

E. A. Hanushek

Studies of educational production functions (also referred to as input–output analyses or cost–quality studies) examine the relationship among the different inputs into the educational process and outcomes of the process. The studies typically employ statistical techniques, quite commonly some form of regression analysis, to separate the effects of different inputs and to estimate the magnitude or significance of any relationships. Because of the statistical methods employed in these investigations, studies in this class have concentrated on outputs, or learning outcomes, that can be quantified and measured. These frequently have involved use of performance on standardized tests; however, many of the studies have also assessed performance in other measurable dimensions.

These studies have attempted to separate the various factors influencing students' performance. The analyses have relied upon statistical, as opposed to experimental, methods to assess the operations of schools and the efficacy of various policies, and the work has been surrounded by considerable controversy which, at least in part, derives from the conclusions of such analyses. These analyses suggest that variations in school expenditures are not systematically related to the performance of children. Moreover, many common policy suggestions, such as reducing class sizes, are not supported by the evidence.

The studies of educational production relationships have covered many different schooling situations, grade levels, and measures of outcomes. From these, there is a remarkably consistent finding that schools are not economically efficient. At the same time, differences in family backgrounds and in schools and teachers have dramatic effects on student achievement.

1. The Origins of Educational Production Functions

The history of educational production function analysis is traced to *Equality of Educational Opportunity*, or, more commonly, the Coleman Report (Coleman et al. 1966). The Coleman Report was mandated by the Civil Rights Act of 1964 and was conceived of as a study of the distribution within the United States of educational resources by race or ethnic background. However, the study went far beyond simply making an inventory of school resources. It created a massive statistical base containing survey information for over one-half million students found in some 3,000 separate schools. And, most importantly, the study attempted to ascertain which of the various inputs into the educational process were most important in determining the achievement of students.

This was not the first such study, but it is both the best known and the most controversial of all such studies. Because of the controversy, a large number of critiques, policy discussions, and further research activities have been generated (see, for example, Hanushek and Kain 1972, Bowles and Levin 1968, Cain and Watts 1970). An important element of the subsequent analysis was consideration of how such work should be conducted and interpreted.

The production function approach to the analysis of education has not been universally accepted. Part of the reaction against such study appears to be a reaction against the specific results (for example, as described below, these studies tend to suggest that schools are very inefficient in their use of resources); part appears to reflect a general reaction against doing any quantitative evaluation of education and schools; and, part seems to reflect analytical problems or overinterpretation of the results of specific studies.

The following sections review the conceptual basis of this work and consider the important issues for conducting and interpreting such work. A final section reviews specific findings.

2. The Conceptual Foundations

Production functions are conceptual constructs used by economists in analyzing resource allocation decisions of firms. A firm's production possibilities are assumed to be governed by certain technical relationships, and the production function describes the maximum feasible output that can be obtained from a given set of inputs.

Typically the textbook treatment of production functions considers just the most stylized examples, for example, the choice of amounts of capital and labor to employ in producing some specific output. Knowledge of the production function and the prices for each of the inputs allows for a straightforward solution of the "least cost" set of inputs, that is, the combination of inputs that would produce any given output at minimum cost. The concept of a production function is a powerful pedagogical tool and, in its basic form, appears applicable to a wide range of industries—from education to petrochemicals.

Perhaps the largest difference between the application of production functions to education and to other industries, however, has been their immediate application to policy considerations. Statistical estimates of educational production functions have been entered into a variety of judicial and legislative proceedings and have formed the basis for a number of intense policy debates.

3. Empirical Formulation and Interpretation

For pedagogical purposes, production functions are generally assumed to be known exactly by decision makers.

to involve only a few inputs that are measured perfectly, and to be characterized by a deterministic relationship between inputs and outputs (i.e., a given set of inputs always produces exactly the same amount of output). Furthermore, for decision purposes all inputs can be freely varied.

The reality faced in education (and virtually all other areas for that matter) is quite different from the pedagogical assumptions: the production function is unknown and must be estimated using imperfect data, some important inputs cannot be changed by the decision maker, and any estimates of the production function will be subject to considerable uncertainty. The following section attempts to clarify the major issues faced in employing production functions for educational decision making.

3.1 Specification and Measurement of Output

Production functions relate the various educational inputs to educational outputs. Obviously adequate measurement of educational outcomes is extremely important in such analysis. Indeed some reject the line of research entirely because they do not believe that educational outcomes are (or can be) adequately quantified. A majority of production function studies measure output by standardized achievement test scores, but others have used measures such as student attitudes, attendance rates, and college continuation or dropout rates.

While economic theory concentrates upon varying quantities of a homogeneous output, this is not easily translated into an educational equivalent. Education is a service which transforms fixed quantities of inputs (i.e., individuals) into individuals with different quality attributes. Educational studies rightfully concentrate upon "quality" differences. Here test scores appear to be a particularly convenient and attractive measure of student quality differences.

Perhaps the most important concern with standardized tests is the lack of external validation. These tests do discriminate among individuals; that is, they can divide the population into different groups. However, questions are generally selected by criteria internal to tests: (a) their ability to divide students (so that questions that can be answered by all or none of the relevant population are not useful), and (b) their consistency with other questions (i.e., whether individuals getting a given question right tend to get other questions on the test right). Further, a given test should produce the same score if taken at different times by the same individual, and slightly different wordings of questions covering the same concept should yield the same results. None of these relates directly to whether or not tests cover material, knowledge, or skills valued by society.

Clearly, much of the observed interest in school system performance relates to the perceived importance of schooling to future capabilities of students—their ability to cope with and perform in society after they have left school. To be sure, there is some value to knowledge for its own sake, other things being equal, and more knowledgeable individuals may be more interesting, happier, or whatever. However, if schools were perceived to perform a simple monastic role, it is inconceivable that they would receive the attention and interest that they do. Here we consider two dimensions of school effects: the effect on labor market performance and the effect on socialization—that is, political awareness, citizenship, moral values, and so on.

Economists have analyzed the influence of education on earnings and labor market performance (Mincer 1970, Rosen 1977). Sociologists have explored the effects of schooling on occupational choice, mobility, earnings, and the relationship between schooling and personal and family characteristics (Jencks et al. 1972). These studies direct attention to the critical question of what role formal education plays in influencing later lives of citizens, a focus frequently lost in research into school operations.

However, a recurring problem with such studies is the inadequate measure of the education individuals receive. Most commonly, years of schooling is used to measure education (this is even the case in models of human capital production functions; see Ben-Porath 1970). Few measures of the quality of education have been incorporated in such studies. Since the most pressing school policy questions concern how to improve the quality of education, this is a particularly unfortunate limitation.

Some attempts have been made to incorporate qualitative measures, such as information about cognitive abilities of individuals or about school expenditure levels into labor market studies. Such studies have been severely limited by data availability, the necessity to use somewhat peculiar samples, and stringent assumptions about school operations (for example, expenditure studies frequently *assume* that expenditure differences index quality differences). Further, the results with respect to the effects of quality differences have been quite inconclusive. Thus, while these studies offer an important perspective on how to observe educational outcomes, they do not currently provide much guidance to studies focusing on the operations of schools.

Although the relationship of schooling and labor market performance is central to many policy questions, it is not the only area of interest. Hence, studies have also examined the role of education in increasing job satisfaction, in maintaining personal health, and in increasing the productivity of mothers engaged in household production, as well as the effects of the mother's education on the learning of young children. Further, political scientists have considered the effect of education on political socialization and voting behavior, and sociologists have considered the relationship between education and criminality. While these studies have suggested some gross effects of quantity of schooling on other life outcomes, they have virtually never addressed the question of how such outcomes vary in response to differences in school programs and operations.

A more fundamental shortcoming is the superficiality of the conceptual notions of the mechanisms by which education affects skills and later experiences. Cognitive skills, the chief measure of educational quality, may not be the only, let alone the most important, outcome of schooling in determining individuals' future success. One might think that more educated individuals can accomplish given tasks better or more swiftly, but surely this holds for only certain types of jobs. Less education may even be better in jobs requiring manual skills or jobs that are very repetitive. One rather commonly held presumption is that better educated individuals are able to perform more complicated tasks or are able to adapt to changing conditions and tasks (Welch 1970, Nelson and Phelps 1966). This hypothesis has important implications for studying the productivity and outputs of schools through understanding of the mechanisms by which school interacts with the work place. Such understanding could provide considerable insight into how to measure the outcomes of schooling (or at least where to look) and how these outcomes might change with the character of the economy. The lack of conceptual clarity holds equally for the potential outcomes of the educational system.

The uncertainty about the source of schooling–earnings relationships is also highlighted by recent attention to "screening" aspects of schooling. Schools may produce more qualified individuals *or* may simply identify the more able. The latter view has been the subject of both theoretical and empirical treatment by economists and sociologists (Spence 1973, Wolpin 1977, Layard and Psacharopoulos 1974). Most of the attention paid to screening models arises from the implication that the social value of schooling may be considerably less than the private value if schools are merely identifying the more able instead of actually changing their skills. Further, the screening model suggests both possible reinterpretation of the historical contribution of education to economic growth (Denison 1974) and revisions of expectations about future returns to schooling (these revisions depend upon the "quality" of the screening function as schooling distributions change and the response of firms to any such changes). However, there are also direct implications of the screening model for the measurement of educational outcomes and the analysis of educational production relationships. In a screening model, the output of schools is information about the relative abilities of students, and this would suggest that more attention should be directed toward the distribution of observed educational outcomes (instead of simply the means) and their relationship to the distribution of underlying abilities. Further, the interpretation of some studies, such as those of school dropout rates discussed below, might be radically altered, since schools with a higher dropout rate might actually be providing better information (higher output) than those with lower rates—an interpretation that is very different from that of the authors of these studies. Unfortunately, no persuasive test has been devised to distinguish between a screening model and the more standard "production" model.

These two views, production and screening, are not the only models explaining subsequent performance. For example, Jencks et al. (1972) argue that luck and personal characteristics (that are unrelated to schooling) are the most important determinants of earnings differences. Bowles and Gintis (1976) believe that earnings differences arise chiefly from the existing social structure and that schools adjust to rather than determine subsequent outcomes. While these latter two views are not completely convincing, available evidence does not conclusively differentiate among these four divergent views.

In summary, there is uncertainty about the appropriateness of test scores as outcome measures. Studies of lifetime outcomes, while conceptually very relevant to measuring school outputs, have not been particularly illuminating for the study of school production functions. Existing empirical evidence is inconclusive about the strength of the linkage between test scores and subsequent achievement.

Nevertheless performance on tests is being used to evaluate educational programs, and even to allocate funds, and there are some pragmatic arguments for the use of test scores as output measures. Besides their common availability, one argument is that test scores appear to be valued in, and of, themselves. To a large extent, educators tend to believe that they are important, albeit incomplete, measures of education. Further, parents and decision makers appear to value higher test scores—at least in the absence of evidence that they are unimportant.

A more persuasive argument for the use of test scores relates to continuation in schooling. Almost all studies of earnings which include both quantity of schooling and achievement differences find significant impacts of quantity that are independent of achievement differences. This implies that achievement differences do not adequately measure all skill differences. However, at the same time, test scores appear to have an increasing use in selecting individuals for further schooling and thus may relate directly to the "real" outputs through the selection mechanism (Dugan 1976). The use of tests for predicting future school performance and for selection is also central in Wirtz et al. (1977), which reviews the decline in Scholastic Aptitude Test (SAT) scores.

Finally, a few miscellaneous issues about output measurement should be noted. First, if one does use test score measurements, there are a number of choices related simply to the scaling of scores. Tests are often available in "grade level" equivalent, percentile ranking, or raw score forms, all of which provide the same ordinal ranking (except for the possibility of some compression of the rankings). Yet, for most statistical work, one wants a scale which indicates how different individuals are rather than one that simply ranks them. The choice really depends upon the relationship of these estimates of output to the subsequent outcomes and is best seen as a special case of more general questions about the functional form of production functions. Second, there is some movement toward criterion-referenced tests—tests that relate to some set of educational goals. The crucial issue is the development of goals. The previous discussion argues for goals that relate to performance outside of schools, but it is not obvious that these goals guide much of the current development work.

3.2 *Multiple Outputs*

Most educational production function studies have analyzed a single output or, alternatively, a series of output measures without consideration of their interactions (exceptions include Levin 1970, Boardman et al. 1977, Brown and Saks 1975). If indeed the educational process is best characterized as producing a set of outcomes (for example, cognitive skills and political awareness) and if there are important interactions among them in production, interpretation of commonly estimated models for a single outcome becomes complicated.

Commonly employed statistical techniques (in particular, ordinary least squares regression analysis) are inappropriate when one or more of the "inputs" are themselves determined by family and school inputs. Such a situation, called simultaneity, requires specialized techniques. Alternatively, it is possible to substitute the input relationships for each of the simultaneously determined inputs and then to apply standard techniques to the resulting "reduced form" relationship. Proper estimation of these more complicated models does require considerable knowledge of the structure of achievement relationships.

Consideration of multiple outputs suggests that production functions estimated for single measures of test scores might be more appropriate in earlier grades, where the emphasis tends to be more on basic cognitive skills—reading and arithmetic—than in later grades. In other words, these outputs appear to be much more heavily weighted than others at earlier grades, and therefore the potential problems of multiple outputs are less than in later grades. (Note that all production function studies have been conducted for elementary and secondary schools. In postsecondary education, few people believe that test scores adequately measure outputs.)

3.3 *Inputs to the Production Process*

A common prescription for developing the relevant set of inputs to a production process is to find an engineer who will describe the technical characteristics and specifications of the process. When considering education, the "engineers" are usually thought to be learning theorists. Nevertheless, almost all educational analyses begin with laments about the lack of any learning theory that is suitable for guiding input–output analyses.

In education, the relatively fixed input of labor and capital (i.e., one teacher per classroom with a relatively small variance in class size) implies that this simple description of inputs could explain little. Somewhat ironically, because educational studies have attempted to provide much more detail about input differences, they have been faced with much more criticism about the specification of the inputs. Part of this criticism is explained by the fact that input specification has not received close attention in many past analyses. The choice of inputs seems, sometimes explicitly, to be guided more by data availability than by any notions of conceptual desirability (Hanushek and Kain 1972).

The typical conceptual model depicts the achievement of a given student at a particular point in time as a function of the cumulative inputs of the family, of peers or other students, and of schools and teachers. These inputs also interact with the innate abilities, or "learning potential," of the student (Hanushek 1972, 1979).

The first important point is that the inputs are those that are relevant to the individual student. Additionally, the model portrays the educational production relationship as cumulative: past inputs have some lasting effect, although the value in explaining output may diminish with more distant inputs. A corollary to this last point is that without fairly strong assumptions about the dynamics of education—that is, the time paths of adjustment to change—the data requirements are huge.

In part to circumvent some of the data requirements (and in part because of other considerations discussed below), an alternative version of this model, often called a "value added" specification, has sometimes been analyzed. If the achievement relationship holds at different points in time, it is possible to concentrate on just what happens educationally between measurements. In the simplest form we could consider simply the difference in achievement in two different years. This difference in achievement could then be related to the specific inputs over the same period. In other words, instead of attempting to describe the entire past history of educational inputs, the analysis would concentrate upon a more restricted period. (This term value added simply refers to the interpretation of estimated models. Beginning and ending achievement for a student will differ because of the achievement added over the period.)

In actual analyses, however, it is generally preferred to include the initial achievement measure as one of the inputs. There are three reasons for doing this: (a) empirically, output measurements, particularly test scores in different grades, may be scaled differently; (b) levels of starting achievement may influence achievement gain; and (c) correlated errors in achievement measurement may suggest such a formulation (Cronbach and Furby 1970). However, the latter argument suggests that further corrections for errors in the exogenous variables—probably based upon test reliability measures—are also needed since such errors, even if they have zero means, will yield inconsistent estimates. This general form, the value-added speci-

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Available analyses, however, do not correspond completely to the conceptual models. Most analyses are purely cross-sectional and include only contemporaneous measures of the inputs. No studies have adequate measures of initial endowments (or "learning capacity"). Many educational inputs (e.g., family educational inputs) are not measured directly, but instead are proxied by other observable attributes (such as socioeconomic background of the family). Little attention is given to the dynamic structure, that is, how the effects of different inputs cumulate. The relevant inputs (e.g., school factors) are often measured with considerable error.

The divergence of the conceptual model and the empirical models which have been estimated means that interpretation of the empirical results often requires a series of implicit assumptions, some of which are very dubious. The remainder of this section attempts to make explicit the most important assumptions underlying the empirical analyses.

The most consistent and obvious divergence of the empirical models from the conceptual models is the lack of measurement for innate abilities. In fact, there is little clarity about what should be measured in this term. Presumably, it includes "learning capacity," but this is not well-defined.

In a regression framework, the effect of omitting an important variable is bias in the estimated regression coefficients. The size of the bias is related both to the strength of the variable on achievement and the correlation of the omitted variable with other included variables in the model. If innate abilities were uncorrelated with all of the included variables, the only effect would be to increase the residual variance, and there would be no bias in the other coefficients estimated. However, there is some evidence that these correlations are not zero. If innate ability is related to IQ scores, we know that, in particular, IQ is correlated with family background (either through genetics or environment). This implies that the omission of innate abilities probably biases upwards the estimated impact of family background on achievement. At the same time, it is plausible to assume that biases in other parts of the model will be considerably less, particularly in the case of school inputs. The correlations between innate abilities and school attributes, after allowing for family background factors, is likely to be small. Likewise, the importance of these omitted factors is lessened if the model is estimated in value-added form, since "level" effects would already be included in entering achievement and only "growth" effects of innate abilities would be omitted. [See Boardman and Murnane (1979) for a discussion of potential biases in alternative specifications.]

The next major category of empirical problems is the accuracy of variable measurement, a problem which occurs in several different forms. Frequently, only contemporaneous measures of the exogenous variables are available, implying that the cumulative variables are generally measured with considerable error. Even if the errors of measurement have a mean of zero, the coefficients will be biased; the amount of bias is roughly proportional to the variance of the measurement error relative to the variance of the true variable (Hanushek and Jackson 1977 Chap. 10). In this case, however, the errors of measurement for background factors (and the biases in these coefficients) are probably less than for other factors, since current measures of backgrounds give a better picture of historical factors than either current measures of peers (because of migration or changing of schools) or current measures of school inputs. These measurement error problems are undoubtedly less severe in value-added formulations where the relevant history covers only a limited period.

Background characteristics are generally measured by a variety of socioeconomic variables. Conceptually, the variables should measure the direct learning provided in the home along with attitudes and so on, and past research suggests that the learning environment in the home is highly correlated with socioeconomic status. For policy considerations, however, it is important to note that the measures of socioeconomic status are only proxies for some more fundamental characteristics, and it is unlikely that changing the measured characteristic (for example, current income) will have much of a short-run effect on achievement.

The biases from "historical" measurement errors are probably most severe for schooling inputs and, to a lesser extent, for peer influences. (With respect to historical peer measurement issues, the problems are most acute in the case of racial composition and integration, since these tend to change abruptly over time.) Common "contemporaneous" measurement errors probably also are most severe in the case of school inputs. Much analysis has tried to capitalize on readily available school data that are produced routinely for administrative purposes. Typically, these data provide measures of average teacher or school characteristics, but are not linked to individual students, as called for in the conceptual model. In fact, schools are often very heterogeneous institutions with considerable intraschool variance in staff and programs. This problem assumes increased importance at higher grade levels where student programs are more varied and hence where average characteristics may give very misleading indications of the actual inputs to any given student. In most studies, measurement errors are probably most important in the case of school inputs.

Frequently, educational production functions are interpreted as if the included variables are conceptually and accurately measured, when in fact this is not the case. However, the severity of such problems differs significantly across studies and clearly explains part of the apparent inconsistencies in findings.

Typically, the school inputs used in empirical analyses include objective measures of teacher characteristics, such as education levels and experience, and schools, such as age of school buildings. Some also include more detailed aspects of teachers, such as undergraduate majors or teacher verbal ability, which can be interpreted as simply attempting to measure homogeneous "quantities" of inputs. While these fit clearly in the conceptual framework, consideration of the organizational context of schools and characteristics of the educational process itself introduces a set of conceptual problems with the production function terminology and framework. Typically (outside of education), measures of organization and process are seen as irrelevant in estimation. Production functions are interpreted as the relationship between inputs and outputs, any necessary changes having been made. Information about production possibilities is viewed as being publicly available in the form of scientific and engineering knowledge, and production processes are reproducible through blueprints and machinery. The possibility of dynamic choices in process made by the actors in production is not considered, and the choice of "best" process is assumed to be automatically made after selection of inputs. While the appropriateness of this framework is open to question in a wide number of instances, it is particularly questionable in the case of education.

In the education context, there are two separable classes of issues. First, there are observable "macro" organizational and process characteristics of the school (such as class organization, curricula, departmentalization, and length of the school day), which represent clearly defined and reproducible educational practices. Second, there are aspects of the process that are difficult to disentangle from the characteristics of individual teachers (such as classroom management, methods of presenting abstract ideas, and communication skills).

The first set of factors can readily ~~be~~ accommodated in the conceptual framework (although the actual empirical implementation may be more difficult). While decision makers may not accurately perceive the impact of various macro-organization and process choices and thus may not make the best choices, production functions can be estimated conditional upon these factors. In fact, there has been some, although not extensive, investigation along these lines.

However, the second type of process effect creates more serious problems, both for the application of the general conceptual model and for the interpretation of any estimated effects. Many educational decisions are "micro" ones made by the actors themselves—mainly teachers. These are both difficult to observe and measure and, quite possibly, not easily reproduced. As a shorthand description, these factors will be referred to simply as "skill" differences. Once the possibility of skill differences is introduced, the language—if not the conceptual framework—of production functions begins to fail. It is even difficult to define just what "maximum possible output" might mean since it is difficult to specify what the "homogeneous" inputs are.

These individual differences are quite important. One explanation of the apparent insignificance of macroprocess variables (Armor et al. 1976) is the great variation in implementation of overall process decisions at the classroom level. This is also supported by detailed analysis of the implementation of innovative techniques at the classroom level (Berman and McLaughlin 1975). Finally, more direct analysis indicates that roughly only half of total teacher performance can be explained by measured teacher and classroom attributes (Hanushek 1972, Murnane and Phillips 1981).

Recognition of skill differences has implications for discussions of "efficiency in production" (discussed below). It also alters our interpretation of teacher and school inputs. It is still reasonable to consider the impact of measured attributes of teachers, since many school decisions such as hiring and salary are based upon a set of these characteristics. However, the estimated impact of these measured attributes, following the above discussion, indicates the ability either to predict or to develop more skilled teachers. For example, the almost universal finding that more education of teachers has no impact on achievement can be interpreted as indicating that teacher-training institutions do not, on average, change the skills of teachers. Or, alternatively, the frequent finding that class size has no effect on achievement may arise from complicated (and unobserved) interactions with teacher process choices; therefore, while it is possible that smaller classes could be beneficial in specific circumstances, it is also true that, in the context of typical school and teacher operations, there is no apparent gain.

One implication of this discussion is that more effort should be devoted to understanding and measuring both the micro- and macro-organization and process characteristics of schools. This represents a distinct break from the tradition of production function analysis. There is no presumption that schools systematically choose the best process given the inputs; thus, estimates of education "technology" must be made conditional upon the chosen macro-organization and process characteristics. At the individual teacher level, the estimated impact of teacher characteristics can be thought of as reduced-form coefficients which include both direct effects (for example, of teacher experience) and indirect effects through systematic choice of microprocess.

3.4 *Efficiency in Production*

One important issue is whether or not schools are efficient in production. This has important policy implications since inefficiency indicates the possibility of increasing school outputs with no additional inputs (or expenditures). However, there is a prior statistical and interpretive issue: since estimation is based upon the observed behavior of schools, the estimated relationships may not trace out the production frontier if schools are not producing the maximum output for given inputs. In such cases, the relationships will describe average behavior, which may not be particularly useful in predicting how changes in inputs would affect outputs.

Traditionally, two concepts of efficiency are considered. Economic efficiency refers to the correct choice of input mix given the prices of inputs (and the production function). Technical efficiency refers to operating on the production frontier, that is, maximizing output for a given set of inputs. Past efficiency discussions have blurred these two concepts and, more importantly, have neglected consideration of how expanding the usual concept of production functions to recognize both macro-organization and process choice and skill differences of inputs affects efficiency discussions.

Two arguments have been used to support the assertion that schools are technically inefficient. First, educational decision makers are apparently not guided by incentives to maximize profits or to conserve on costs. Second, they might not understand the production process and therefore cannot be expected to be on the production frontier. The first argument, while raising the possibility of economic inefficiency, does not necessarily imply being off the production frontier unless resources are also wantonly squandered. The second argument is generally related to the importance of macro-organizational and process choices. The relevance of these factors can be analyzed, and, importantly, their presence does not significantly alter the interpretation of empirical analyses as production functions. Direct analyses of these factors, while not completely conclusive, do not indicate their overwhelming importance.

The possibility of skill (or "embodied process") differences among inputs to schooling introduces a different aspect into the efficiency discussion. The standard conceptual framework indicates that if two production processes are using the same inputs, any systematic difference in outputs reflects inefficiency. However, the concept of skill differences simply recognizes that individuals with the same measured characteristics make a series of important production decisions (reflected in behavior, process choices, and so on) that are difficult to identify, measure, and model. Therefore, it is not surprising that the same measured inputs yield variations in output, but at the same time it is difficult to label such observed variation as efficiency differences.

Introduction of skill differences does not, however, eliminate the usefulness of a general production framework. For many purposes, the desired information is what aspects of teaching can be replicated (or predicted) in different situations. Most research has concentrated upon systematic measurable characteristics—the reduced-form models of teacher effects—and these estimates do indicate what can be replicated in the absence of shifts in the underlying structure.

Some research has also estimated the total effects of individual teachers without regard to actual measurement of underlying attributes and confirms that important dimensions of teacher quality are not captured by measured teacher attributes (Hanushek 1972, Murnane 1975, Murnane and Phillips 1981, Armor et al. 1976). An important sidelight of such investigations is that decision makers might be able to identify underlying skill differences among teachers with fair accuracy. Murnane (1975) and Armor et al. (1976) find that principals' evaluations of teachers were highly correlated with estimates of total effectiveness. For many purposes, this is almost as good as the ability to identify differences ex ante.

Finally, concern about technical inefficiency has led to some (basically nonstatistical) estimation of the production frontier (Levin 1976, Klitgaard and Hall 1975). Besides assuming accurate measures of both inputs and outputs, this analysis appears internally inconsistent: it is motivated by the perceived uncertainty about the production process, yet assumes that the researcher knows and measures all of the inputs to the production process. Further, the possibility of nonreproducible skill differences is totally neglected.

3.5 Statistical Issues

(a) *Basic methodology*. The choice of statistical techniques depends upon both the specific purposes and the empirical specifications of the models. For policy purposes, one typically wants to know how students' achievement will change with a policy change (such as reducing class sizes). For this, estimation of regression coefficients is generally desirable and analysis of variance techniques will not be appropriate (Hanushek and Kain 1972, Cain and Watts 1970). The specific technique is, however, dictated by the structure of the models. For example, while ordinary least squares is often appropriate, alternatives are called for when there are simultaneous relationships (see Sect. 3.2 above) or when aggregate school data are employed (Hanushek 1972).

(b) *Level of aggregation*. While the conceptual model is at the individual student level, much analysis—relying upon data collected for other purposes—is actually conducted at a more aggregate level, such as the school or district level. The effects on the estimates of such aggregation depend crucially upon the nature of educational relationships.

In the simplest case, when the production process is approximately linear in the same parameters for all students, regression estimates on the aggregate data will be unbiased, although probably less precise than if individual data were available. In more complicated situations, aggregation has less innocuous effects. For example, if two groups of students—say, blacks and whites—have different production relationships where the differences are not easily parameterized, estimation with aggregate data yields "average" coefficients which depend upon the weighting of the two groups in the sampled observations and which are difficult to interpret.

Nevertheless, probably the most serious aggregation problem is really one of errors of measurement. The researcher frequently has individual data about students (such as achievement and family background), but only aggregate data about schools. The temptation is to use all available data by mixing individual characteristics with aggregate school data. However, the school factors relevant to any individual may differ significantly from the average (consider, for example, the situation in a large comprehensive high school). Here, aggregation generally helps; the errors in measurement for a model of average achievement and average characteristics are almost certainly less than individual achievement and average school characteristics (Hanushek and Kain 1972, Hanushek 1972).

(c) *Selection effects and causation.* For policy purposes, information about causal relationships between school factors and achievement is needed. However, such information (about the direction of causation) cannot come directly from the observed data and correlations, but must be introduced from a priori information about the structure of the overall model. The primary concern in the production function setting is the effects of teacher selection and assignment mechanisms.

Consider the simple case of an observed positive relationship between teacher experience and student achievement (holding other factors constant). Depending upon the mechanism by which teachers are assigned to schools, this need not imply that increasing average experience levels in a school will increase achievement (i.e., that there is a causal relationship running from experience to achievement). If, for example, more senior teachers were allowed to choose their schools and teachers had a preference for teaching higher achieving students, then achievement would, at least in part, "cause" experience; and a policy change that increased experience would not yield the (full) effect on achievement expected from the estimated relationship. Other, and more subtle, selection effects might also occur; more educated or more intelligent teachers may, through their own efforts or the direct assignments of principals, be placed in "faster" classes.

The situation is really another case of simultaneous equation bias. The importance of these effects depends upon the importance of achievement in determining assignments of different types of teachers, and there has been little direct analysis of this. The appropriate solution is estimation of the simultaneous system, but this has not been done.

Greenberg and McCall (1974) analyzed a single urban school system in the early 1970s and concluded that race and socioeconomic background of students were systematically related to the selection and transfer of teachers with different education and experience levels. However, Murnane (1981) suggests, from analysis of a different school system, that declining enrollments and the subsequent surplus of teachers have led to a much greater reliance on institutional rules and much less on individual teacher preferences (which was the hypothesized mechanism in the Greenberg and McCall study).

Nevertheless, the potential problems arise from achievement affecting selection, and not from family background, race, or other factors that are included on the right-hand side of the estimated model affecting selection. In the latter instance (which would be a recursive structure), even though some correlation among the right-hand side variables may be induced by this mechanism, there are generally not serious problems; without other such selection effects, the estimated relationships with achievement can plausibly be interpreted as causal relationships. Clearly the severity of the problem is related to the structure of the model estimated and in many instances is only serious in the presence of fairly subtle selection mechanisms (particularly in a value-added specification).

(d) *Multicollinearity.* Since discussion of multicollinearity in educational research by Bowles and Levin (1968), it is taken as an almost ever-present but lamentable fact of life in estimation.

The statistical story is that disentangling the separate effects of exogenous variables which are very highly intercorrelated can be difficult. Further, in the usual case of positive intercorrelations, the parameter estimates themselves will tend to be negatively correlated so that quite commonly a coefficient has the "wrong" sign because of the correlations of variables.

Nevertheless, the importance of multicollinearity is probably overrated. All correlations of exogenous variables do not have serious consequences, and all low *t*-statistics and wrong signs are not the result of multicollinearity. Right-hand side variables are often called independent variables, but this does not imply that they cannot be correlated. In fact, multiple regression analysis is used because there are correlations among the "independent" variables.

The importance of multicollinearity depends crucially upon the statistical methods used. In particular, analysis of variance such as used by Coleman et al. (1966) is extremely sensitive to intercorrelations of the variables, while standard regression analysis is not nearly as sensitive (Hanushek and Jackson 1977).

4. Past Results

Studies of school performance and educational production functions have proceeded at a fairly even pace since the Coleman Report in 1966. By 1986, some 144 separate estimates of production relationships can be found in the literature. These studies have tended to concentrate upon the aspects of schools that can be manipulated for policy purposes. High on the list of these factors are the items, or characteristics of teachers, that go directly into the expense of schools. In particular, instructional expenditures, which comprise over three-fifths of current operating expenses of schools, are determined chiefly by three factors: teacher salaries, average class sizes, and number of students. Moreover, looking at instructional expenditures per student, we see why studies pay so much attention to experience and degrees of teachers and to class sizes: these essentially determine the per student costs.

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Past studies are thoroughly reviewed in Hanushek (1986). However, they are quite easy to summarize.

(a) There is no consistent evidence that class sizes affect student performance.

(b) There is no consistent evidence that degree level of the teacher affects student performance.

(c) There is some, but not overwhelming, evidence that teacher experience might be related to student performance.

These statements reflect an attempt to compile the results of the different studies. This attempt involved recording the sign and statistical significance of the separate estimates. The results are quite startling. Of 109 studies investigating teacher–student ratios, a majority suggest that *larger classes* are associated with higher student achievement (holding other factors constant). Similarly, a majority of the 64 studies that report on the relationship between teacher degree level and student achievement find that achievement is lower in classes where the teacher possesses an advanced degree.

The wrong message should not be gleaned from this evidence. This does not suggest that teachers are all the same. It likewise does not say which are the better and which are the worse teachers. The studies indicate that there are dramatic differences among teachers and schools in terms of the performance of individual students. However, the best teachers are not the highest paid, the most experienced, or the ones with the most schooling. The good schools are not the ones that spend the most. The good classrooms are not the ones with the fewest children. They may be any or all of these in specific school systems or specific circumstances, but there is no consistency across schools and experiences.

Another way of putting these findings is that they indicate that the typical school or school system is quite economically inefficient—it is paying for things that are not consistently related to students' performance.

The past work does show very consistently that family background is highly related to student performance. It does not, however, pinpoint with any accuracy the specific attributes of families that are important. Moreover, there is no indication of how such knowledge might be useful in designing educational policy.

While the past research has been hampered by lack of completely suitable and consistent data, much has already been learned from these studies. Moreover, the appropriate interpretation of past work and the most profitable ways to focus further analyses are quite clear.

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Educational Technology

F. Orivel

The production of educational services is a sector where the relationship between inputs and outcomes is much less clearly identifiable than in most other sectors of production of goods or services. What is the effect on educational results of a better qualified teacher, a lower pupil–teacher ratio, or educational media such as audiovisual aids, television programs, or computers? There is some evidence on these questions, but it is very often contradictory or inconclusive. These uncertainties are due to the variety of educational outcomes (cognitive and affective, internal and external, immediate and long term), and to the difficulty of measurement of most of them, in spite of some significant progress, at least in the measurement of cognitive achievements.

Most educational systems or educational institutions do not consider as a major and central objective the optimal use of inputs to maximize their outcomes, not only in public educational systems, but even in supposedly competitive private institutions. The survey carried out by Bowen (1980) among American colleges and universities leads to the conclusion that in higher education institutions, both private and public, unit costs are determined quite simply by the amount of money that can be raised from diverse sources: it is the "revenue theory of cost." The analysis of the relationship between expenditures (or costs) and outcomes (quantitative and qualitative) is basically inconclusive. It seems that the variance of costs is much higher than the variance of outcomes, which would mean that a certain number of institutions could have the same results with less resources. But on the other hand, the author argues that in its present trend, American higher education tends to be underfinanced and that the quality is declining.

These apparently contradictory results mean two things: there is a likely relation between available resources and academic excellency, but the right inputs remain to be specified. The provision of better educational services, leading to better educational results, requires more resources, and is therefore more expensive. But more expensive educational services are not necessarily better ones if the right inputs have not been clearly identified.

Traditional teaching takes place in classrooms with a teacher facing students. The teacher has the main role, and the basic additional input is the use of textbooks. The concept of new educational technologies is applied to systems where the traditional system is either enriched, or completely redesigned, in order to provide a substitute for the traditional system. Such a substitute is essentially covered by the concept of distance education.

An important aspect of both enrichment in traditional schools and distance education is that they were not originally introduced to improve the cost–effectiveness ratio of educational systems. Enrichment is aimed at improving school performances, fighting against failures, dropouts, repetition rates, and so on. Distance education objectives are mainly to provide access to education to excluded segments of the population: sick or handicapped people, mothers raising children, working people, adults who did not have the opportunity of studying while they were children, people living in remote areas, etc. The introduction of distance education for such target audiences was motivated principally by equity rather than economic considerations.

The situation in the early 1980s is entirely different. Most countries, especially the poorest, are facing dramatic budgetary difficulties which have stopped the expansion of public resources allocated to education (Eicher and Orivel 1979). This shrinking of resources for education accelerated in the second half of the 1970s behaviorism. The danger that people will think that such vulgarities say all there is to be said about achievement seems all too real. That achievement might stretch beyond what instruction seems to permit through, for instance, independent study, has no place in this world view. The possibility of learners achieving objectives and passing tests but being alienated from the subject matter as a result of the instruction and the prevailing ethos surrounding achievement, is likewise ignored. Nor is there any acknowledgment that achievement builds on achievement in a so far unexplained fashion, that knowledge accumulates synergistically as connections are made and unassimilated material is suddenly assimilated. Rather the image is of chunks of achievement lying about with no means of putting them together. No doubt this is why it is not always appreciated that the achievement of fixed common goals may be attained by individuals only at the cost of differential achievement of other goals (Messick 1981), which may not be in their best interests.

6. Reconceptualizing Achievement

Much of what is being identified here as unsatisfactory can be traced to the habit of reducing achievement to one-dimensional terms when what is wanted is a stereoscopic view. It starts with some way of thinking—let's not call it a model—of how achievement accumulates, into which all the elements mentioned so far can be fitted—the connections, the aftermath of mastery, the changes that take place as skills and knowledge develop. It goes on to seek better definition of achievement in its conventional cognitive sense. Evidently, group testing places a ceiling on performance, mastery learning tests likewise; it is not known what else people might be capable of. It may be necessary to run unconventional "open" achievement testing alongside conventional "closed" testing to satisfy curiosity about what people can do, to add to what they are supposed to be able to do as a result of instruction—not only what people can do unaided but also what they *might* be able to do with sympathetic help cf. Vygotsky's exciting notion of the "zone of next development" and associated concepts (Glaser 1981). Exposing learners to instruction in advance of development so as to draw them up, implies tests to assess levels of learning that might possibly be attained. Note the heresy of having tests go beyond instruction, and the implications for question writing.

Achievement needs to be understood within the context in which it occurs, the school or college. This means paying attention to noncognitive states conveniently regarded as extraneous but which affect and are affected by achievement, or lack of it. A strong plea for taking motivation and self-esteem explicitly into account has been made recently (Scarr 1981). It is very much in line with the view that tests should be treated as only one part of an assessment procedure and work should be done on ways of helping teachers better use the other observations which they so frequently employ in the classroom (Shulman 1978). Testers do a disservice by ignoring complexities in favor of their own procrustean creations.

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Wastage in Education

W. Loxley

In their quest to meet the social demand for formal education given limited resources, ministries of education around the world have sought to eliminate educational wastages caused by repetition and dropout. The removal of education inefficiencies are necessary if universal primary education, equality of educational opportunity, and widespread literacy are to increase. Indeed, UNESCO (1980) estimates that roughly 25 percent of all primary-school places in the developing world are lost to educational wastage. Although educators deplore these wastage rates, it is probably true that if there were fewer dropouts and repeaters, some similar reduction in student enrollment would have to be invented in order for budgets to meet the tremendously expanded school enrollment at the higher levels.

Hence, the dilemma facing educational planners is how to increase the flow of pupils through the educational system by reducing educational wastage while simultaneously maintaining the quality of the system at reasonable per pupil cost. In the remainder of this article, the definition of educational wastage including its measurement will be discussed, the relationship between repetition and dropout will be explored, some pedagogical reasons for and against repetition policies will be examined, and, finally, worldwide patterns and trends in educational wastage will be traced.

1. *The Concept of Educational Wastage*

Educational wastage is an economic term defined as the total number of pupil-years spent by repeaters and dropouts. A repeater is a pupil who, in a given school year, remains in the same grade as in the previous year, while dropouts are those who leave school before the end of the final year of an educational cycle in which they are enrolled. As a summary measure, wastage ignores both the benefits afforded the repeater by spending an extra year in school and the benefits accruing to the dropout before leaving school. Total wastage, then, merely reflects the drag of repetition and dropout on the flow of promotions within an educational system.

Of the two components, repetition is thought to be more wasteful because repeaters (a) stay in school longer than normal duration thereby reducing the intake capacity, (b) cause the loss of investments in educational services and increase unit costs, and (c) contribute to dropout while having a regression effect on equity in the educational system. Inequalities arise because failure to be promoted at a normal pace is greatest for rural inhabitants and those of low socioeconomic standing (Haddad 1979).

2. *Ways of Measuring Wastage in Education*

Haddad (1979 p. 4) and UNESCO (1980 pp. 14–16) present various formulas for computing educational wastage. To quantify an international index of wastage poses many obstacles, but one method conveniently measures school output by the number of "pupil-years" attributable to all primary schoolers where a student who spends one year at school is said to have spent one pupil-year. Educational wastage is defined in this unit as the total number of pupil-years spent by repeaters and dropouts and can be converted into a percentage of the total number of pupil-years accruing to a student cohort. For example, if a student drops out after grade three having repeated two and three once each, calculations would show the pupil to have spent five pupil-years: two as a repeater and three as a dropout.

There is no one best way to measure wastage because within school systems some repetition may be due to individuals transferring from rural to urban schools (this could lead to undercounting promotion and repetition rates and thereby overestimating dropout in rural areas). Sometimes pupils pass a year-end examination but repeat a grade again due to a lack of capacity in the next grade (see Robinson 1980 for a case study of repetition and dropout as push-out). In some multilingual societies, repeating the first grade may be a prerequisite for pupils to master the language of instruction which is different from their local dialect (e.g., Quechua, Aymara, and Guarani versus Spanish in Latin America). Finally, high rates of repetition in the final grade of primary education may be due to pupils trying to obtain favorable results needed to qualify for admission to secondary school.

In all, caution is needed when comparing educational wastage across nations because educational systems are not alike structurally, promotion policies and achievement norms differ, and dissimilarities arise in data estimates where, for example, overreporting the number of initial enrollees will ultimately exaggerate the number of students who turn up as dropouts.

3. *The Relationship Between Dropout and Repetition*

The 1980 UNESCO report on educational wastage, using correlational data analysis to isolate determinants of repetition and dropout, concludes that "... dropout is closely related to the factors governing the demand for the supply of education (while) the level of repetition depends more on factors internal to the educational system" (UNESCO 1980 p. 6). This finding supports earlier studies conducted on determinants of dropout in developing countries (Levy 1971). Accordingly, an automatic promotion policy represents a supply and demand factor which turns out to be inversely linked to the amount of dropout in a system. Likewise, a lack of places in the upper grades is more likely to cause dropout than would failure at taking exams (an internal factor). Still it seems fair to say that underachievement, which is most likely to cause repetition, will ultimately lead to dropping out especially as the maximum number of per pupil repetitions allowed is exceeded.

In summary, the direction of causality between repetition and dropout is still not well-understood. To help establish the causal connection between the two components of educational wastage, data are needed which show the proportion of dropouts who have case histories of multirepetition. This suggests the need for sample surveys and longitudinal tracer studies.

4. *Nonpromotion Versus Automatic Promotion Rules*

Much debate has centered on the use of promotion practices to alter educational wastage rates. Policies favoring repetition over automatic promotion are most often rationalized by a set of pedagogical assumptions, of which the one most commonly cited says that since not all children mature or learn at the same rate, slower pupils can profit by being given an extra year to grow.

Opponents of repetition forcefully countercharge that retention not only fails to improve the learning of the underachiever, it adversely affects a pupil's self-concept (Haddad 1979 pp. 8–16). Consequently, if repetition does not increase learning while simultaneously reducing self-esteem, it seems unfair to make dropouts and repeaters feel they are the failures when in fact nonpromotion criteria seem so unreliable. Clearly, large-scale experimental studies are needed to decide these issues, but the current consensus of opinion to be that promotion is at least as desirable as repetition (Haddad 1979). As such, the issue should not be so much whether to favor automatic promotion over a policy of repetition, or compulsory attendance over dropping out, but rather to seek ways to improve the overall quality of the schooling experience equally for everyone.

Hence, what emerges is a two-pronged strategy to fight educational wastage: (a) to keep repetition rates as low as possible in the first several years of primary school to ensure educational opportunities for all, and (b) simultaneously, to improve the quality of the school environment through a constant upgrading of teachers, curriculum, facilities, and so on in order to reduce repetition and dropout caused by underachieving.

Since upgrading school quality while creating additional places in the higher grades for those who might otherwise repeat or drop out is bound to be a costly venture, educational planners will be hard pressed to keep costs manageable. This realization returns one to the initial dilemma stated earlier which involves the struggle to increase educational opportunity while maintaining educational standards with the same level of per pupil expenditures.

Patterns and Trends in Educational Wastage

Although considerable disparities in the level of educational wastage exist between countries due to regional variations, differing educational structures, and so on, certain patterns and trends have been observed across regions of the world. For example, differences in repetition and dropout by sex generally favor girls. The fact that females repeat less frequently than males is assumed a consequence of higher initial preselectivity among girls.

By grade level, more repetition is found in the final grades of the primary cycle in Africa where students often repeat until they pass the primary school leaver examination. In Latin America, as in Asia, higher rates of repetition are found in the lower grade levels, while in East and West Europe, and North America, little repetition and dropout exist at all. In addition, higher rates of repetition are commonly found in rural areas of the world's nations, even though transferring from rural to urban schools, which is widespread, causes an overreporting of dropout rates in rural areas.

Data collected by UNESCO (1980) over the 10-year period from 1966 to 1976 reveals that for all regions both repetition and dropout rates have remained stable despite massive growth in the world's educational system. However, absolute numbers of repeaters and dropouts have increased as a result of that growth.

Finally, it might be mentioned that wastage rates for general secondary education, when compared to primary wastage rates, are lower in Africa and Latin America and higher in Europe and Asia. But because the meaning of general secondary educational wastage is dissimilar to that found for primary schools, and the data less reliable, secondary-school wastage is not dealt with in this article.

6. *Patterns of Repetition and Dropout by Regions of the World*

The overall primary-school wastage rate for less developed countries is reported by UNESCO (1980) to be about 27 percent, divided by regions as follows: Africa 34 percent, Latin America 28 percent, Asia 22 percent. This compares to only 3 percent for the developed regions. The estimate of total wastage means that on average nations will spend one-quarter of all pupil-years invested in a given cohort on repetition and dropout. When educational wastage is broken down into its constituent parts, the impact of repetition and dropout on wastage by region can be noted. Table 1 presents the current breakdown by region of the world based on 1976 data published by UNESCO (1980) and measured in pupil-years due to repeaters and dropouts as a percentage of total pupil-years.

It appears that about 15 percent of primary-school pupils are repeaters in the developing countries, which suggests that the number of primary-school children admitted to class could have been increased by some 15 percent without increasing the costs had there been no repetition. Disparities are largest in Africa (e.g., Tanzania 0.4 percent, versus 47 percent in São Tomé and Principe). There are wide variations in Asia also but since data for some of the larger Asian nations

Table 1
Average median repetition and dropout rates (1976) by region for primary schools[a]

	Repetition rates[b]		Dropout rates[c]	
Region	%	No. Countries	%	No. Countries
Africa	16.5	40	22.0	36
Latin America	11.0	24	28.0	23
Asia	10.0	33	16.0	32
Europe	2.0	22	3.0	18

a Percentages, based on regional median averages, are calculated in pupil-years b Repetition rates computed from Table 3.1 (UNESCO 1980) c Dropout rates taken from Table 4.2 (UNESCO 1980) are absent, it is likely that the 10 percent figure is underreported.

Table 1 also conceals high levels and large dispersions within and between regions for dropouts. For example, the dropout rate for French-speaking African nations is 28 percent, while for English-speaking African countries the level is only 19 percent.

In conclusion, wide differences in the rates and dispersions of educational wastage between countries suggest that each nation will have to formulate its own policy to eliminate primary-school wastage in the future. But such strategies, however organized, will surely pay dividends if, as a result, widespread literacy, universal primary education, and increased educational opportunities are forthcoming.

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University Internal Efficiency

D. W. Verry

Efficiency as defined by economists relates to consumption choices by individuals and the choice of outputs and inputs by producers. It is possible to specify rules which ensure that in each of these areas no reallocation is possible which would make one individual better off without making another worse off (the economist's definition of Pareto efficiency). However, it is hard to apply such rules to universities in any operational sense. Instead, it is possible to discuss in a more informal way how output choices ought to reflect consumer preferences and input choices be responsive to relative input prices if the spirit of such efficiency rules is to be adhered to. When one examines the incentive structure embedded in the current practice of resource allocation to and within universities it seems highly unlikely that the efficiency rules are even approximately followed. In their dealings with central resource allocators individual universities are encouraged in the present system to act as revenue maximizers rather than cost minimizers. Individual university departments face similar disincentives, while the method by which university teachers are hired and promoted encourages excessive concentration on research relative to teaching. Without necessarily increasing the role of private provision or financing of university education it would be possible to improve efficiency by making university administrators and teachers more responsive to student demand and to input prices.

1. *The Meaning of Efficiency: Economic Concepts and Their Application to Higher Education*

Economists have no exclusive claim to the correct definition of efficiency. Nevertheless, as much of their professional effort is devoted to specifying necessary and sufficient conditions for the attainment of efficiency as they understand it, it will be instructive to begin by considering the concept as defined by economists. This will be done intuitively rather than rigorously (any standard text in microeconomics or welfare economics will provide a fuller and more rigorous treatment—see for example Layard and Walters 1978). At the same time an attempt will be made to indicate how these notions of efficiency apply to universities. Again, this will have to be suggestive rather than comprehensive. A full specification of efficiency conditions in higher education, taking account of the diversity of subjects, institutions, and the abilities and tastes of producers (teachers, administrators) and consumers (students, taxpayers) would be a mammoth, if not impossible, task.

Economists make much use of the concept of Pareto efficiency or Pareto optimality (after Vilfredo Pareto, an Italian engineer and economist 1848–1923). A Pareto efficient or optimal state is one in which it is impossible to make one person better off without making another worse off. Pareto efficiency in turn implies: (a) efficient consumption, meaning that outputs are consumed or purchased in such proportions that no reallocation could make one consumer better off without making another worse off; (b) production efficiency, meaning that with given resources it is not possible to produce more of one output without producing less of another; (c) efficient choice of outputs (product-mix efficiency), meaning that it is not possible by altering the mix of outputs that can be produced with given resources to make one person better off without making another worse off.

These three efficiency conditions do not, however, imply a unique configuration of inputs and outputs. There will, in general, be many such configurations which are Pareto optimal in the sense of fulfilling the three efficiency conditions defined above, with each such configuration corresponding to a different distribution of individual utilities (well-being). What is required if society is to choose among these Pareto efficient solutions is some way of deciding which of the feasible distributions of individual utilities is preferred.

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The Contribution of Education to Development

P. Foster

Although economic development is conventionally defined in terms of a rise in real gross national product (GNP) per capita, a distinction can usefully be made between development and growth. Growth may involve no major changes in factor inputs nor any transformations in existing institutions. By contrast, development presupposes a process of innovation in which new technologies will be generated and new input and output mixes will emerge (Flammang 1979). In sociological terms, it implies that major social and structural change will occur involving a process of institutional transformation in sectors that are only peripherally linked to the core of the economy.

Historically in the developed world and currently in the less developed countries (LDCs) development has involved the monetization of local economies and the progressive substitution of subsistence by exchange activities; a growth in the proportion of populations living in urban centers with the associated phenomenon of enhanced migration rates; the emergence of new systems of social differentiation based on occupation and income in contradistinction to those based primarily on lineage and descent; and, finally, the creation of new forms of polity based on the nation–state.

These transformations have not been uniform in all societies and for this reason the term "modernization" has less currency in the literature than formerly, conveying as it does the idea of unilineal evolution or societal convergence toward some general stage of "modernity." However, the broader notion of the institutional transformations that are associated with development suggests that patterns of change are uneven: development is neither a smooth nor a continuous process and tension emerges as between institutional sectors that are undergoing differential rates of change. Indeed, much of the more specifically economic literature concerned with development has ignored the sociological dimension and remained somewhat insensitive to the institutional and normative constraints within which the process takes place.

As development proceeds, educational institutions, both formal and informal, undergo a corresponding shift in function. Within so-called "traditional" societies education is concerned with the transmission of received knowledge, the maintenance of broad societal consensus, and the perpetuation of existing patterns of social differentiation. These functions do not disappear as development continues but the balance shifts towards the utilization of educational institutions as agencies in the selection and allocation of individuals and groups to various economic roles and positions within the social structure. Thus education becomes an independent variable in the process of social change and as structural differentiation increases it emerges as a quasi-autonomous institution that can both facilitate or even impede the development process. The whole literature on education and development is ultimately concerned with this issue: the specific problem of measuring the effect of enhanced educational inputs upon economic outputs must be seen within a broader historical and sociological perspective which attempts to examine the problematic relationship between education and development in the widest sense.

1. A Historical Review

Research confirms that by 1800 literacy had been acquired by the vast majority of males and about one-third of adult females in the countries of North America and northwestern Europe. The evidence suggests that a substantial literacy base was a necessary if not a sufficient prerequisite for the massive economic transformation that occurred in the northern hemisphere during the eighteenth and nineteenth centuries. However, inter- and particularly intra-national variations in the diffusion of schooling and literacy were substantial and continue to persist in more muted form. Further, the literature shows that substantial differences in levels of educational development cannot be explained primarily in terms of state intiatives but are to be seen largely as a result of a rise in public demand stemming from changes in the economic environment and the emergence of more complex and interrelated national occupational structures (Craig 1981).

While not ignoring the significance of local historical and cultural circumstances, it is fair to say that the expansion of formal education in the contemporary less developed world has followed a similar pattern. Quantitative educational growth appears to have a definite ecology and it has been closely associated with the monetization of local economies, the growth of urban centers, the development of transport networks, and the appearance of new occupational opportunities, access to which becomes increasingly dependent on formal schooling. In many less developed communities these developments were initially associated with colonial rule but, as in the developed world, rates of intranational educational development were and remain very uneven. Likewise, the role of colonial regimes in stimulating educational development was often limited: indeed the dynamics of educational expansion were often such that they ran counter to colonial and currently postcolonial educational policies.

Thus, while the specifically economic literature concerns itself with the measurable individual and social returns to educational investment and uses these as an indicator of the contribution of education to economic development, a historical or sociological perspective emphasizes the essentially interactive relationship between the economic and educational dimensions. Educational expansion is initially consequent upon a degree of structural economic change having already occurred in local economies, though it may, in turn, become a catalyst for further economic development. For example, although a broad literacy base may be a prerequisite for sustained growth (some have suggested a threshold of 30 to 40 percent) it is apparent that a demand for literacy and schooling will not emerge unless traditional social and economic structures have already been partly integrated into a broader exchange economy. If economic development is an objective the diffusion of schooling among desert nomads or subsistence farmers and cattle herders can hardly be considered a policy priority.

This suggests that the role of schooling as an instrument of economic development will be highly variable over time. In colloquial terms, the expansion of formal education (classified by sector and type and not in gross terms) may have a substantial "payoff" at some stages in the development process while at others its impact may be negligible in terms of other development options that may be available. Thus in spite of the spate of literature on the role of schooling in development that has appeared since 1955, failure to recognize this caveat has led to overly simplistic educational policy prescriptions. In fact, rather than constituting the key to economic and social development, education might be properly regarded as a component in a jigsaw puzzle whose linkage with other pieces is as yet obscure.

2. *Research and Policy Issues since the Second World War*

The principal strands of what Bowman first termed the "Human Investment Revolution in Economic Thought" (Bowman 1966) have been delineated and commented upon by her and subsequently by Sobel (1978) and do not require extensive treatment. Some brief comments are, however, appropriate. As noted, the human capital approach is a largely post-Second World War phenomenon whose roots can in part be traced to the productive outcomes of aid programs to the war-devastated regions of Western Europe and Japan as contrasted with the more equivocal consequences of the transfer of physical capital and technology to the less developed world. The effectiveness of such transfers, it was suggested, depended on the existence of educated populations who could effectively utilize them. Concurrently, research in the United States had led to the conclusion that historically just over 40 percent of the growth of per capita income in that country could be inferentially attributed to educational investment in people. It must be recognized, however, that commentary or research of this nature had virtually no implications for educational policy. Its general effect was rather to create a climate of opinion that was favorable to enhanced educational investment in both the developed and less developed nations, without at the same time providing any meaningful guidelines as to the optimal form of such investments or any suggestion as to how education actually contributed to the development process.

The same reservations can be attached to the various exercises in national correlation comparisons that reached their apogee in the widely published work of Harbison and Myers (1964) on human resource indicators. Although a contemporaneous correlation analysis using similar measures of educational development had suggested that primary schooling and literacy were more highly correlated with level of economic development than the provision of secondary or tertiary education (Anderson and Bowman 1963), the human resource indicators developed by Harbison and Myers were weighted in such a manner as to emphasize the greater contribution of postprimary and particularly tertiary-level technical and scientific education to economic development.

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Unfortunately, although the creation of indicators of educational development requires a degree of technical expertise, the assumptions underlying the whole correlation approach were simplistic in the extreme. Governments bent upon educational provision inferred that simple correlations had causal significance and reached the erroneous conclusion that rates of economic development were largely determined by the supply of high-level manpower, particularly in the technical and scientific fields. The equally plausible assumption that developed nations had larger pools of such skills because they were developed received little attention.

Retrospectively, it could be argued that the human resource indicator approach had deleterious effects on the developmental efforts of some nations. It led to a distortion of resource allocation toward higher levels of the educational system while primary schooling was viewed largely in terms of its feeder role to the secondary sector. Indeed, educational systems as a whole were seen as passive suppliers of skills to the occupational structure with no independent role, as it were, in the development process. Finally, the belief that scientific and technical training would make a greater contribution to development than general education was without foundation.

Similar strictures can be applied to the whole practice of manpower forecasting, whose rationale was closely linked to the intellectual assumptions of the resource indicator approach. Besides overemphasizing the contribution of tertiary training, manpower planning was based on a set of largely untenable assumptions, viz: zero price elasticity for skills, low levels of substitutability between factor inputs, and above all a more pervasive belief in a unilineal pattern of structural economic change. The latter assumption had particularly unfortunate consequences where less developed countries based their estimates of manpower "needs" on "labor coefficients" that were presumably based on means derived from manpower distributions prevailing in developed nations.

By the early 1970s both the assumptions and consequences of manpower forecasting activities had become increasingly unacceptable. Indeed, it is roughly from this date that a decline can be noted in the belief in the efficacy of macroeducational planning as an instrument of economic development. Thereafter, planning for development took on a far more pragmatic emphasis and based itself on increasingly limited and short-range sets of objectives (Windham 1975).

This new trend was not only a result of the demonstrable failures of macroplanning but stemmed from a substantial literature based on cost–benefit (rate of return) analysis, whose assumptions concerning the role of education in development were totally at variance with those of the manpower and macroplanning traditions. The historical origins and assumptions of cost–benefit analysis, its major empirical findings, and its principal policy implications have been treated by Psacharopoulos in two major cross-national studies (Psacharopoulos 1973, 1981). The results have been to question both the premises and major conclusions of the manpower planning approach. Briefly, the findings are that in all countries private and social rates of return are highest at the primary level; all rates of return to investment in education are above the 10 percent common yardstick of the opportunity cost of capital; returns to education in less developed countries are higher than the corresponding returns in developed countries, and rates of return to general education are, in general, higher than those for technical, scientific, and more specifically vocational types of training.

The policy implications of these findings are clear. Both developing and developed nations would do well to pay particular attention to the quality and provision of schooling at lower levels while at the same time adopting a more skeptical attitude to the development of highly specific (and high-cost) forms of technical and vocational training. In particular they should be conscious of the dangers of expansion and massive public subsidization of tertiary education where the individual rates of return may be substantial but the social benefits far more problematic.

In recent years the cost–benefit approach has itself come in for criticism (Blaug 1976). Basically, most objections stem from a degree of skepticism concerning the nature of the relation between productivity and observable income–education profiles. Some of these criticisms are, in fact, not incompatible with the assumptions of cost–benefit analysis but others have a greater measure of cogency, particularly in the context of less developed countries characterized by a relatively small "modern" exchange sector but with a far greater proportion of the population involved in subsistence or semisubsistence activities. In these nations analytic problems of specification and measurement are formidable and the calculation of rates of return thus more hazardous. Moreover, although the approach works well in terms of explaining individual investment behavior, its definition of social rates of return is perhaps more questionable and intuitively less convincing.

Despite these reservations it is fair to say that the positive contributions of the cost–benefit approach (in contrast to those of the manpower tradition) have far outweighed its limitations. Its initial assumptions are more flexible and provide a means by which a crude and partial estimate of the economic consequences of educational expansion can be made. More pragmatically its findings concerning the relatively greater importance of basic and primary education in the development process are more consonant with the demands for social equity that are salient in many less developed nations.

3. *Equity and Opportunity*

In the two decades after the Second World War a climate of optimism concerning the putative economic benefits of educational investment led to a massive expansion in educational provision in both the developed and less developed nations. In the former, growth occurred at the secondary and particularly tertiary levels but in the less developed countries absolute enrollments in primary schools rose massively. Everywhere, however, rates of expansion were greatest at higher levels. Integral to most expansionary policies was the notion that development not only involved rises in GNP per capita but that increased educational provision would be associated with the equalization of educational opportunities (defined at that period largely in terms of access and continuance in schooling).

In the event, growth was associated with a series of unanticipated consequences that were not predicted in the conventional economic literature and which in the less developed countries stemmed largely from uneven rates of structural change. Although it was recognized that early educational development had been associated with major inequalities in access to schooling in terms of the region or the ethnic and social provenance of students, it was believed that these disparities would largely disappear as development proceeded.

In terms of intermediate stages of educational expansion this view was erroneous: while absolute levels of enrollment everywhere rose, regional differentials in access also increased, with the gap between "leading" and "backward" areas becoming more pronounced. This was the result of a "piling up" of resources in more advanced regions, which social geographers termed the "backwash effect." In themselves, such inequalities were not incompatible with policies designed to maximize the short-term contribution of education to economic development, but in the long run the political and economic consequences of these disparities could be serious, particularly where regional inequalities were conjoined with ethnic differences in plural societies. Although political decisions concerning the allocation of resources invariably have economic consequences it is equally true that policies dominated by economic criteria have political effects which, in turn, influence future rates of economic development.

Thus, almost uniformly, economically oriented strategies had to be tempered by policies designed to minimize the most salient inequalities resulting from development. These took the form of special educational aid to "backward" regions or, in some cases, the de facto imposition of "ethnic quotas" in educational recruitment. The long-term consequences of such policies are, as yet, obscure but in the short term they seem to have had no radical effect on the distribution of educational life chances: once patterns of inequality emerge their eradication is less a matter of decades but generations. However, the issue remains even more salient in the less developed countries as a result of the limited resources at their disposal and the fact that rates of return to education are higher than in the developed world.

Although regional or ethnic inequalities persist in muted form in developed nations the inequality of opportunity issue in them tended to focus on the relation between educational achievement and social background. (The term "social class" must be used with reservation in many less developed countries.) However, in all societies it was anticipated that educational expansion would eradicate disparities ultimately stemming from the social background of students. This issue has little to do with the degree of aggregate mobility in a society for this is overwhelmingly determined by the rate of structural and economic change, but rather concerns the extent to which educational achievement is influenced by social origins and how far final social or occupational position is predicted by achievement level independent of social background.

Institutional or structural studies, of course, show that throughout the developed and less developed world educational access and continuance is correlated with social background. However, in many less developed coutries a substantial minority (or even majority) of students at the more selective levels of education come from lower status families. This is partly a result of the heavy weighting of most of the population toward the lower end of the occupational spectrum, but it implies that substantial inequalities in life chances can be associated with considerable "openness" in educational access. The issue is whether such openness will continue as development proceeds. Status transmission studies in a variety of societies are suggestive in this regard.

Everywhere, social background is the strongest single predictor of educational achievement but, of equal importance, it is rather less significant in the less developed countries than in the developed nations, particularly in the least developed areas, for example sub-Saharan Africa. Moreover, in all societies the final social (or occupational) status achieved by an individual is only weakly predicted by his social background and mainly in an indirect fashion through educational achievement. Of equal importance, however, is the fact that the direct influence of educational achievement on final status is rather stronger in the less developed countries than the developed nations.

What are the implications of these findings in macro-developmental terms? If it is assumed that economic development requires a degree of "openness" in status hierarchies it is fair to say that educational systems have served this function reasonably well. They have everywhere mediated the effects of ascribed social status and even where aggregate mobility rates are low (as in most less developed countries) there is a degree of fluidity in social structures consequent, in large measure, upon educational expansion. This is not to suggest, however, that the latter radically reduces inequalities in the pattern of life chances of individuals or groups insofar as these are determined by social background. Indeed, the influence of social background on level of educational achievement is if anything higher in more developed countries. In the less developed countries it is possible that as development proceeds processes of incipient "class formation" may increase the influence of social background on achievement and

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if this phenomenon is, in turn, associated with low levels of structural mobility, development might result in an increasing degree of rigidity in social structures and a decreasing amount of circulation of individuals and groups within the social structure.

Such a development is not inevitable but it suggests that as with regional, ethnic, or even income differentials the development process does not in itself reduce social inequalities—it may frequently increase them. In sociological terms development does not imply a simple unilineal movement from "ascription" to "achievement" or from "particularism" to "universalism."

4. "Overeducation" and Urbanization

In developed nations postwar educational-expansion was associated with rapid economic development and burgeoning occupational opportunities. The demand for educated manpower tended to keep pace with increasing supply and thus in cost–benefit terms private and social rates of return remained constant or fell only marginally. However, given a current diminution in development rates there is evidence that average rates of return are falling (particularly at the tertiary level) though they may still vary significantly by type of education.

It has, therefore, been contended that the current labor force is "overeducated" and a growing skepticism has emerged concerning the profitability of continued educational investment. It should be noted that the term "overeducation" is ambiguous in meaning. It may suggest that there is an appropriate level of education for every occupation, which is a form of argument derived ultimately from manpower planning assumptions. Alternatively, it can imply that private and social rates of return to education are lower than could be obtained through alternative forms of investment. Current data would suggest that this is probably not the case but sharp dips in rates of return must not be excluded as a future possibility.

Ironically, current concerns about educational overexpansion in the developed nations were foreshadowed in the literature on the less developed countries by almost a decade. Here it was contended that three sets of interrelated and problematic consequences had emerged from educational growth.

4.1 The Ratchet Effect

In many societies limited mobility opportunities, combined with the domination of the modern employment sector by government agencies, had placed an immense premium on the possession of educational qualifications for job access. Concurrently, the effect of massive public subsidization of education (particularly at secondary and tertiary levels) had enhanced private rates of return and stimulated increasing demand. However, in societies characterized by the presence of a large subsistence or semisubsistence sector the rate of growth in full-time wage employment opportunities in the small "modern sector" was never commensurate with the increase in supply of educated manpower. This led to a rapid escalation in the minimal levels of education required for job access which, in turn, generated further demand for higher levels of schooling. This ratchet effect has been referred to as "credentialism" or the "diploma disease" in some literature. Its consequence was the displacement of the less educated from their jobs by the more educated, mass unemployment among primary-school leavers, and increasing employment problems for secondary- and even tertiary-level graduates.

That the ratchet effect exists is incontrovertible and ensuing problems of labor market adjustment may be exacerbated by continuing government subsidization of education or relatively inflexible labor-pricing policies. However, the negative consequences of the phenomenon may have been exaggerated so far as the unemployment issue is concerned. First, its incidence is extremely difficult to measure in societies with large semisubsistence sectors. Individuals reporting themselves as unemployed in fact often mean that they have not been able to obtain employment commensurate with their initial expectations given their level of education. A substantial proportion, in fact, may be employed or self-employed within the more informal sectors of the exchange economy while waiting for full-time employment in the formal sector. While this is the case the research literature would suggest that the widespread belief that the educated will only accept employment in white-collar jobs is quite without foundation. Though they may, in fact, wait for opportunities (while often utilizing family support) their expectations are realistic and adjust downwards to market conditions. The literature indicates that unemployment is, in fact, heavily concentrated among younger age groups and first-job applicants while gross unemployment statistics mask considerable internal circulation: the permanently unemployed constitute but a small proportion of these figures. This is not to underestimate current problems of labor market adjustment but the evidence does not suggest a negative return to educational investment and the concept of overeducation is subject to the same caveats as in developed nations.

4.2 Effect on the Rural Economy

In countries where the bulk of the labor force is concentrated in subsistence or semisubsistence agriculture, it is contended that educational expansion has had a deleterious effect on rural economic development. The educated migrate to urban centers thus denuding the countryside of its potentially more productive and innovative cohorts while, concurrently, massive in-migration to the town exacerbates problems of urban unemployment with the attendant "pathological" phenomenon of rising urban crime rates.

A conventional educational solution to the rural problem (short of the politically disastrous policy of limiting schooling in rural areas) has been to suggest curricular reform: the replacement of an ostensibly academic and bookish education by rurally biased curricula which would engender a commitment to life on the land, lower out-migration rates, and impart a degree of agricultural knowledge that would facilitate rural economic development. At the same time, urban unemployment would be reduced through the introduction of vocational education in the schools matched to the needs of the urban labor market.

Research suggests that this analysis is misleading. While the propensity of rural individuals to migrate to the towns undoubtedly increases with level of formal education, the educated may only form a tiny proportion of the total group of migrants. Moreover, the argument of rural denudation is not sustained: in view of population distributions as between town and countryside a very low rate of overall rural out-migration can be associated with massive increases in urban populations. Indeed there is now some evidence that the propensity of the educated to migrate actually diminishes if the imbalance between urban and rural opportunities becomes less pronounced. In the urban context there is little evidence, however, that employment opportunities have in fact deteriorated while the contention that urban unemployment is associated with in-migration is, in some cases, refuted by the data: migrants often fill positions that nonmigrants are unable or unwilling to occupy, while recent migrants may be better qualified than nonmigrants to fill many positions (Hawley et al. 1979). Moreover, field studies of school leavers would suggest that, although they may visit urban centers for variable periods to seek employment, a substantial proportion return to the villages if disappointed.

The analysis rests, indeed, upon the creation of a false dichotomy between town and countryside that ignores the symbiotic relationship between urban and rural development. Capital resources, both human and physical, flow back and forth between the two: income derived from urban employment is ploughed back to stimulate rural development while this, in turn, diminishes the propensity to migrate. Migration and urbanization thus make a positive contribution to the overall development process and attempts to artificially restrict their incidence are both counterproductive and ineffective. In particular, attempts to control "urban drift" through curricular reform have everywhere been unsuccessful, although such notions still have some vogue in less developed nations. The propensity to migrate is a function of perceived alternative occupational opportunities and has nothing to do with what is taught in schools. Moreover, the thesis that an agriculturally oriented vocational curriculum in the schools will contribute in any substantial manner to rural development rests on a fundamental misconception as to the role that formal education plays in the development process. The same can be said regarding the provision of specifically vocational education to counteract urban unemployment (Foster 1965).

4.3 The Dual Labor Economy

It has been contended that another dysfunctional consequence of educational development in the less developed countries has been the emergence of a "dual labor economy." This implies the existence of a very small, highly paid modern employment sector manned by an educated minority alongside a massive informal sector wherein the bulk of the labor force enjoys, at best, marginal rates of subsistence. In its extreme form the thesis may assert that rising standards for the small minority are associated with an increasing "immiseration" of the masses: a contention refuted by the demonstrable fact of universally rising life expectancies among all strata. In order to be empirically acceptable the dual labor market thesis would have to show that income distribution is indeed bimodal, with the peaks concentrated at the extremes and nothing much in between. Research suggests that this is not the case: earnings in the informal sector overlap with those in the highly paid formal sector (though the mean is lower) and they are significantly higher than in agriculture (Gregory 1980). All this suggests that the range in income is considerable (far greater, as is well-known, than in developed countries) while the bulk of the labor force is concentrated at lower levels: an unequal distribution of income, however, is hardly the same thing as a dual distribution.

In summary, the problems discussed above do not suggest that the expansion of formal education has had negative consequences for development in both developed and less developed countries. In some cases, they lack empirical support while in others they simply draw attention to issues stemming from uneven rates of change as between institutional sectors: these are an inevitable consequence of the development process. However, the problems that have emerged might in some cases have been mitigated by more informed market-oriented educational policies. Finally, although the economic literature indicates that thus far both private and social rates of return to educational investment have been high this is no reason to suggest that they may remain so. To assume this would be to make an extrapolation of existing data as unwarranted as that of the earlier generation of manpower planners.

5. How Does Education Contribute to Development?

Although the economic literature presents a convincing argument concerning the role of education in development, it remains relatively silent concerning what it is that schooling actually does to people that makes them more productive, nor has it been so concerned with those putative "spillover" effects of education which may contribute indirectly to development. Discussion on spillover effects has tended to focus on the relations between education and political development and schooling and population growth.

It has been asserted that insofar as economic development is facilitated by a political framework that provides an orderly process of transfer of power and low levels of political violence, the expansion of schooling should indirectly stimulate development. This inference is based on survey data (mainly collected in more developed nations) pointing to a relationship between level of education and democratic political attitudes and also to cross-national studies which indicate that the political stability associated with an orderly transfer of authority and low levels of violence is confined to those relatively few countries whose populations exhibit high levels of literacy and general education.

These data must be treated with extreme caution as must all forms of simple correlation analysis, for it is demonstrable that the process of development is linked not only with rising levels of education but with an increased incidence of violence and political instability. Moreover, in less developed nations education is neither associated with increased personal commitment to the nation–state nor to the existing political order (however stable). Basically, the evidence concerning education and political development is so unsatisfactory (and perhaps ethnocentric) that the nexus between education and political and economic development is problematic in the extreme. If in the long run educational development is shown to be plausibly (and causally) linked to stable and democratic policies then so much the better. Currently, the data do not establish a basis for pursuing educational policies based on this assumption.

Likewise the literature on education and population growth is ambiguous in its implications. In spite of the literature concerning the negative effects of rapid population expansion there is evidence that a growth in population based on increased life expectancies is associated with an increasing rate of savings and capital formation and an enhancement of productivity. Generally there seems to be an inverse relation between education and fertility acting indirectly through deferred marriage and knowledge of birth control but there is a rise in fertility among women with up to three or four years of schooling which declines thereafter. Unquestionably education is associated with increased life expectancies due to improved nutrition and illness diagnosis and also with an income effect involving higher expenditures on food and housing. Basically, however, the relationships between education, population growth, and economic development are so complex that population control cannot be considered as a rationale for educational expansion. Once again, if a positive spillover effect occurs then this is desirable but it cannot, at present, enter into major policy considerations.

Research on what education actually does to people to make them more productive has centered principally upon the social–psychological research of McClelland and Inkeles (McClelland and Winter 1969, Inkeles and Holsinger 1974) which suggests that education may operate through a transformation of values and attitudes that have direct implications for development. McClelland has attempted to show that historically periods of development have been associated with a rise in the "need for achievement" among populations. He has argued, on the basis of limited evidence, that a rise in the need for achievement can be obtained through educational means thereby stimulating economic development. In a closely related tradition, Inkeles and others have suggested on the basis of substantial cross-national evidence that the emergence of "structural modernity" is associated with an individual attitudinal correlate, viz the "modernity syndrome." Individual modernity scores are raised through experience in modern work situations but level of formal education is everywhere the strongest predictor of such scores. Although Inkeles himself stresses the "correspondence" between structural and attitudinal modernity, his work would imply that a principal contribution of education to development lies in its ability to transform individual attitudes and values from the "traditional" toward the "modern," thereby enhancing the rate of structural modernization in a society and plausibly rates of economic development.

Other traditions have placed particular emphasis on the role of literacy and enhanced communication in development. Some have argued that a literate tradition is essential for the emergence of "formal rationality" in any society (Goody and Watt 1968). Others have suggested that insofar as development depends on the effective transmission of new information in complex social systems the role of education lies particularly in its effect on the costs of such informational transfers. In the context of the less developed countries the recognition of the importance of literacy and education in facilitating communication processes essential to development stem directly or indirectly from Lerner's early research (Lerner 1958).

It must be recognized, however, that although research in the social sciences has provided a series of plausible hypotheses concerning the "intervening variables" that explain the relationship between education and economic development, the direct policy implications of such research are by no means self-evident. Indeed, one of the weaknesses of earlier developmental planning was that tentative research findings were used selectively to justify educational policies that had been decided upon for very different (often political) reasons.

6. Some General Developmental Strategies

Notwithstanding the limitations of current knowledge it is possible to delineate a few broad lines of policy that stem from the more robust findings of economic and social research. Such policies designed to maximize the contribution of education to development will be necessarily tempered by the exigencies of politics and alternative or conflicting educational objectives in both the less developed countries and the developed nations.

Most of the literature tends to emphasize the greater importance of general education and the significance of literacy and numeracy in the development process. It is questionable whether highly specific forms of vocational and technical training represent an efficient form of investment unless they are closely geared to on-the-job experience and actual labor market conditions. Earlier manpower planners tended to see the role of education as lying essentially in the provision of specific skills, but it is manifest that most formal systems of education do not and cannot function in this manner. Formal schooling is essentially complementary in nature to less formal systems that impart such vocational skills and the weakness of many earlier educational strategies lay in their disregard of the existence of highly efficient informal educational structures. Perhaps formal schooling largely through the provision of literacy, numeracy, and general education generates a basic "ability to learn" that is vital in the innovatory development process.

This, in turn, implies the greater importance of basic and primary education in development, particularly in the less developed countries. In the latter, the issue has become increasingly one of upgrading quality as much as expanding quantity. Correspondingly, greater caution needs to be exercised in the less developed countries and elsewhere over the expansion of tertiary education, particularly where this is heavily publicly subsidized. Considerations of both equity and efficiency would, in this case, suggest a greater devolution of costs towards the consumers of tertiary education though in all societies such proposals have met strong political opposition.

In general, it is likely that the efficiency of educational systems could be improved by a greater decentralization of decision-making processes thereby effecting a greater responsiveness to market signals and forces at both local and national levels. This type of policy orientation results from a greater understanding of the ecology of educational development and a recognition of uneven rates of structural and economic change within national boundaries. The manifest failures of macroeducational planning suggest the need for new micro- and pragmatically-oriented policies that can be rapidly adjusted to meet changing circumstances.

Finally, in the case of the less developed countries greater emphasis must be placed on the development of rural areas so long neglected in earlier educational planning. The evidence now seems overwhelming that education is associated with substantial gains in the efficiency and productivity of farmers (Lockheed et al. 1980). However, it is equally clear that such gains are maximized in environments that are already changing rather than in static traditional circumstances. The effect of education seems to depend upon the existence of literacy and numeracy (rather than the provision of agricultural education in the schools) but schooling must be regarded as an accelerator in the rural development process: its role will be limited without the existence of other modernizing elements. Once again this points to the interactive relation between schooling and other aspects of change in the development process.

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Education and Economic Growth

N. L. Hicks

Economic growth of a steady and positive nature has been a consistent goal of most countries since the Second World War. For developed countries, economic growth means reduced unemployment as well as real increases in the social welfare of the population. For developing countries, there has been the added goal of trying to raise their standard of living to a level commensurate with that of the advanced countries, and to reduce widespread poverty and deprivation. But the attainment of high, steady rates of economic growth, measured by the growth rate of gross national product (GNP), has been an elusive goal for many countries. In attempting to understand the growth process, economists have examined the relative importance of investment in capital stocks, technical progress, changes in the size and quality of the labor force, and other factors.

The contribution of education to growth is presumed to occur through its ability to increase the productivity of an existing labor force in various ways, including both technical training and general education. But exactly how education increases productivity, how important it is, and in what ways it is important, are difficult questions which remain unsettled.

In primitive societies, basic education of known techniques of production was generally handed down through oral teaching, often associated with some form of apprenticeship system. A modern growing economy requires more people who can read and write in order to keep financial records, read plans and blueprints, and carry out similar functions related to the production and distribution of goods and services. Higher levels of per capita income are also based on a higher level of scientific and technological attainment, requiring a larger number of scientists, technicians, and engineers to conduct research and oversee the technological adaptation of research. However, while a shortage of educated people might limit growth, it is not clear that promoting education will foster more rapid growth. Furthermore, it is not clear what kinds of education are best at assisting growth—general formal education, technical training, or informal education related to specific jobs.

In general, countries that have higher levels of income also have higher levels of educational attainment (see Table 1), but this cannot be interpreted to mean that education is a necessary cause of higher levels of output and income. Education is both an investment good and a consumption good. As income grows people demand more education, and can afford more education, both for themselves and more importantly for their children. Whether this education contributes to raising productivity is a debatable point. Education may become a kind of screening device used by employers to make hiring decisions. Faced with a large number of applicants for a given job, an employer tends to narrow his or her options by looking seriously only at those with the highest levels of education. As a result the education level required to gain entry to certain jobs tends to move upward over time with little or no change in basic productivity.

1. Growth Accounting

In order to understand education's contribution to growth, one first must understand the causes of growth and the growth process itself. Traditionally, economists have identified three factors of production: land, labor, and capital. In the growth process land will presumably not change, so that the key factors are the growth of labor and capital. If the growth rates of labor and capital are weighted by their shares in total output, one can derive an index of the growth of factor inputs. The growth of total factor productivity can be measured by the growth rate of total output less the growth of total factor inputs.

More formally, output (Q) is assumed to be a function of the stock of capital (K), the labor force (L), and the level of technical progress (A), which is also a measure of total factor productivity. Hence, $Q = f(K,L,A_t)$ where A is assumed to be a function of time, t. Recasting in terms of growth rates and transposing results in a production function of the type:

$$\frac{dA}{A} = \frac{dQ}{Q} - \frac{dL}{L} + \frac{dK}{K}$$

Thus the term dA/A is a residual between the growth of output and the growth of factor inputs, and is susceptible to errors in the measurement of output, labor, and capital. Changes in the quality of the labor force can also affect the results in a misleading direction. The major work on growth accounting has been done by Denison (1967, 1979). In this work, he makes adjustments for the changes in the age and sex composition of the labor force, changes in hours worked, and most importantly for changes in education. The differentials in earnings at different education levels are assumed to reflect the added productivity of education. Dension acknowledges, however, that earnings differentials can also reflect unmeasurable factors such as ability and family background, and reduces these differentials by 60 percent to allow for these factors. This reduction factor, while somewhat arbitrary, is generally accepted by practitioners of growth accounting as a reasonable estimate, although it indicates that growth accounting itself is somewhat a combination of an art and a science.

For the period 1948 to 1973, Denison estimates that total United States potential national income grew at an annual rate of 3.87 percent per year (Denison 1979 p. 105), while total factor input grew at a rate of 2.2 percent. The growth rate of labor inputs, making allow-

Table 1
Education data: Selected countries[a]

	Per capita income US$ 1980	Adult literacy rate % 1977	Enrollment rates % 1979		
			Primary	Secondary	Higher[b]
Sweden	13,520	99	98	86	37
France	11,730	99	112	84	24
United States	11,360	99	98	97	56
Japan	9,890	99	101	90	29
United Kingdom	7,920	99	105	83	20
Spain	5,400	n.a.	109	78	24
Soviet Union	4,550	100	101	104	21
Romania	2,340	98	98	83	11
Brazil	2,050	76	89	32	11
Korea, Republic of	1,520	93	111	76	12
Tunisia	1,310	62	102	25	5
Philippines	690	75	98	63	27
Sudan	410	20	51	16	2
India	240	36	78	27	8
Bangladesh	144	26	65	25	2

a Source: World Bank 1982 b 1978

ance for hours worked and so on, but excluding education, accounted for 28 percent of total growth. Education of the labor force accounted for 11 percent. This is somewhat lower than Denison's earlier estimates for the period 1950 to 1962, when education accounted for 15 percent of total growth, and other labor inputs only 18 percent. Overall, however, both labor and capital inputs explain about 60 percent of total growth; the remaining 40 percent is accounted for by changes in factor productivity or output per unit of input. A certain part of this productivity growth Denison explains by improvements in resource allocation, changes in the legal and human environment, and economies of scale. There is a large residual, however, labeled "advances in knowledge and miscellaneous determinants," which accounts for about 29 percent of total growth. In Denison's words, "The advance in knowledge is the biggest and most basic reason for the persistent long-term growth of output per unit of input." Broadly speaking, it can be said to constitute nonformal education, and technical and managerial knowledge, obtained in a variety of ways ranging from organized research to simple observation and experience. But the residual also includes other factors which are not advances in knowledge and which are not otherwise incorporated in the estimates, including statistical discrepancies and measurement errors.

If one combines the direct influence of education (11 percent) and the indirect influence of advances in knowledge (29 percent), a very large proportion of growth (about 40 percent) can be attributed to improvements in human capital or education broadly conceived. This proportion furthermore has not shifted dramatically since Denison's earlier work in 1967 (which gave a 15 percent share for direct education and 23 percent for advances in knowledge). However, estimates for the period 1973 to 1976 show a decline in the residual, indicating declining productivity. With total output growing more slowly than total factor inputs, "advances in knowledge" have had a negative contribution of −0.56 percentage points. While a number of alternatives are examined by Denison (higher energy prices, more government regulation, less research and development) no clear explanation of the negative residual can be clearly identified. Thus, it raises the question whether or not "advances in knowledge" have been overstated as an explanation of growth in the past, and suggests that there are other factors at work which are yet to be uncovered in both periods. It is also possible that the shorter period (1973 to 1976) is too brief to capture the lags inherent to a period when the world economy has been undergoing some fundamental restructuring. Furthermore, a review of growth accounting exercises of various countries compiled by Bowman (1980) shows much lower contributions for education in other countries. In 22 countries having estimates for about the 1950 to 1962 period, only in four did the direct contribution of education exceed 10 percent (Argentina, Belgium, United Kingdom, and the United States). For most countries, education seems to be a minor factor, and to be a smaller factor in countries having rapid growth rates. Furthermore, the unexplained residual seems to be larger the higher the growth rate, that is, productivity itself grows faster when total output grows faster. For instance, Japan's growth averaged 10 percent per year during the period 1955 to 1968, of which only 39 percent could be attributed to the growth of factor inputs. Education explained only 1.4 percent of total growth.

Finally, it should be again noted that the size of

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the residual is a function of the methodology and its assumptions. Jorgensen and Griliches (1967) argue that if the inputs and outputs were correctly measured, the residual would be reduced or eliminated. Using different methods for measuring the capital stock, Christensen and Jorgensen (1969) found, for the period 1948 to 1967 in the United States, a growth of total factor productivity of about 0.3 percent per annum, versus Denison's estimate of 1.7 percent.

2. *Returns on Human Capital*

Another approach which attempts to measure the impact of education on productivity consists of recasting education as an investment in human capital. In theories developed by Becker (1964), Schultz (1961), and a host of others, it is assumed that rational people will attempt to invest in education up to the point where returns to them in terms of extra income are equal to the costs of undertaking education, including the income forgone while education is being undertaken. Social returns to education will differ from private returns to the extent that recipients of education do not pay the full costs of this education. On the other hand, the social gains from education will be measured as pretax income, while the private gains will be net of taxes.

Table 2
Social returns to investment in education (%)[a]

Country group	Primary	Secondary	Higher
Developing	27	16	13
Intermediate	16	14	10
Advanced	n.a.	10	9

[a] Source: Psacharopoulos 1981

Decisions on investment in human capital generally relate to the amount of education to give children; income earners usually cannot afford to resume education on a full-time basis or may be barred from doing so. Parents must decide how much of present consumption to forgo in investing in the education or human capital of their children, which is counterbalanced by the real and expected income earned by more educated offspring. Expected returns from education can vary in perception and in fact, and financial markets do not permit sufficient borrowing to allow parents to equate marginal benefits to marginal costs. Thus, it could be expected that rates of return would be higher in less developed countries.

Returns to education have been calculated for many countries, and have been summarized by Psacharopoulos (1981). Basically he finds that:

(a) returns to primary school are higher than those to other levels of education;

(b) private returns exceed social returns, particula
the university level;

(c) all rates of return are above 10 percent (a comm
accepted estimate of the opportunity cos
capital);

(d) returns to education were higher in the po
countries, reflecting the greater scarcities of tra
manpower in these countries.

For developing countries, the high social ret
found for primary education (27 percent) con
sharply with the more modest returns for higher
cation (13 percent) (see Table 2). This suggests
these countries may have overinvested in higher
education, and neglected primary education. For
more advanced countries, the social rates of return
higher education averaged only 9 percent, sugges
that further rapid expansion of higher education w
not be warranted. The fact that private returns
averaged 12 percent, however, indicates that there
still be popular pressure to expand higher educa
beyond the point where it has a net social benefit
any real impact on growth. Thus primary education
developing countries could still make significant c
tributions to growth assuming that other investme
could not match the average rate of return of 27 perc
Further investments in higher education in develo
countries could actually slow growth, if more produc
investments elsewhere are forgone. Thus educatio
impact on growth depends on the level of developm
of both the economy and the labor force, and will
country and time specific. The whole process becor
self-equilibrating: an oversupply of a certain class
educated people will drive down salaries and lo
prospective rates of return, which in turn will discoura
entrants. Where systems of public education are w
developed, and financial markets permit borrowi
against future earnings, rates of return on educati
will, in the long run, equal the rates of return on ot
productive assets. Thus, higher than normal rates
return reflect some sort of market imperfection, such
in developing countries where neither public nor priva
education is available, and people are unable, becau
of their low incomes, to sacrifice present consumpti
levels to finance education. In short, education is like
to be more important to economic growth in situatio
marked by underinvestment in human capital, limit
supplies of skilled and educated workers, and relative
undeveloped education systems. Many would agree wi
Schultz (1975) that education is more likely to be impo
tant in modernizing environments than in tradition
ones.

In developing countries, there seems to be a cle
bias against, and resulting underinvestment in, primar
education, as reflected in relatively higher rates of retur
compared to secondary and higher education. Rece
evidence and work, in addition to the rates-of-retur
evidence, has increased the stress on investing i

Table 3
Education and gaps in per capita incomes between the United States and other countries[a]

Country	Per capita GDP as percentage of US value	Per capita attainable income with present human resources[b]	Percentage by which attainable income is reduced by gap in education[c]
United States	100.0	n.a.	n.a.
Canada	72.6	100.5	8.1
Israel	38.3	83.8	13.6
Japan	14.4	93.2	3.7
Puerto Rico	23.2	59.8	12.6
Jamaica	16.2	56.7	16.0
Panama	15.0	51.5	16.0
Mexico	14.2	45.6	22.9
Greece	12.5	71.2	28.6
Portugal	11.6	67.1	29.9
El Salvador	7.5	45.5	24.1
Honduras	7.5	36.6	23.9
Peru	7.3	51.0	18.3
Iran	7.2	39.8	33.2
Jordan	6.9	38.7	23.3
Malaysia	7.9	44.2	25.0
Indonesia	3.1	37.3	32.2
Korea, Republic of	4.7	44.3	24.8
China, Republic of (Taiwan)	3.9	48.5	21.6
Thailand	3.6	46.5	21.4
India	3.0	34.1	32.6
Ghana	7.7	38.0	30.3

a Source: Krueger (1968) b Per capita income attainable with present human resources if the country has US per capita nonhuman resources c Controlling for age and sector

primary education. A survey of studies on farmer productivity by Lockheed et al. (1980) suggests that the microlevel evidence supports this view. A summary of 31 individual studies covering various developing countries found that four years of education increased farmer productivity on average by 7.4 percent. This average centers around a fairly wide range, however, with several studies showing a negative correlation between education and productivity. The authors explain this by dividing the sample into modernizing/nonmodernizing subsamples. In nonmodernizing societies, marked by traditional and primitive farming methods and little exposure to innovation and new methods, four years of education was found to increase production by only 1.3 percent, compared with 9.5 percent under modernizing conditions.

3. *Cross-country Comparisons*

Other cross-country evidence also supports the idea that human capital development in general, and education in particular, is an important element in explaining variations in growth rates and levels of per capita income. Krueger's study (1968) made a pioneering attempt to compare differences in per capita income between the United States and a wide range of other countries. Her technique consisted of breaking down the labor force by age, education, and rural–urban areas for each country. If each of these categories had the same productivity as that of the United States, an estimate of "attainable income" can be derived. In most cases, even if countries had the same factor endowment as the United States, Krueger finds that they would attain a per capita income only half that of the United States level (see Table 3), with the balance being attributed to the different levels of development of human capital. Mexico, whose 1960 per capita income was 14 percent of that of the United States, serves as useful illustration. If Mexico had the United States' endowment of land, capital, and other resources, it would have had a per capita income of 46 percent of the United States' level. Explained another way, 63 percent of the gap in per capita incomes must be explained by other factors, namely differences in human capital stocks.

It is worth noting, however, that Krueger does not equate human capital entirely to education. Other important differences include the age structure of the population, and the split between rural and urban areas. In most countries, attainable income is reduced by about 15 to 30 percent due to education deficiencies, or about half of the total gap explained by human capital differences. In the case of Mexico, education lowers attainable income by about 23 percent, compared to a total reduction attributable to human capital of 54 percent.

Despite the work of Krueger (1968), Selowsky (1969), and others, education and human capital factors were often ignored in studies of growth in developing countries until recently. This deficiency has been overcome in recent years, however, as economists have been increasingly concerned with such issues as reducing poverty and increasing employment, in addition to promoting growth. Improving the basic health and education of the poor is now seen as an important mechanism for increasing their welfare directly, and their productivity indirectly. This has led to a renewed interest in the "social sectors" consisting not only of education, but also of health services, water supply and sanitation, nutrition, and housing. The question arises whether these are investments or a form of consumption; in much of the development literature before 1970 investments in social sectors were considered to have little or no effect on output growth.

In a recent cross-country study, Hicks (1980) found that the rapidly growing developing countries were those that had above average performance in both literacy and life expectancy. Growth, of course, can add to the resources available for making improvements in health and education. In order to circumvent this cause and effect problem, he examined the growth of a sample of 75 developing countries for the period 1960 to 1977 and their respective levels of achievement in 1960 for life expectancy (an assumed health measure) and literacy. He finds that literacy levels and growth are related. The top twelve countries (see Table 4) had an average per capita growth rate of 5.7 percent during the period, compared to 2.4 percent for all countries. These fast-growing countries started the period with above-average literacy levels: 65 percent compared to an average of 38 percent. However, the fast-growing countries also have above-average income levels, and one would expect higher than average levels of literacy. But even if one adjusts for differences in income, these countries had literacy rates 12 percentage points higher than would have been expected at their income levels.

Correlation analysis such as this suffers from many deficiencies, and the problem of cause and effect identification remains. In addition, Hicks points out the strong correlation between literacy levels and life expectancy, suggesting that literacy may have an important influence on health and hygiene. In a more extensive study, Wheeler (1980) attempted to overcome the causality problems by using a system of simultaneous equations. While more rigorous, this approach reduces the number of countries that can be included in the analysis, since

Table 4

Economic growth and life expectancy: Selected countries[a]

Country	Growth rate 1960–77[b] %	Life expectancy 1960	Deviations from expected levels of life expectancy[c]	Adult literacy 1960	Deviations from expected levels of literacy 1960[c]
Singapore	7.7	64.0	3.1	n.a.	n.a.
Korea, Republic of	7.6	54.0	11.1	71.0	43.6
Taiwan	6.5	64.0	15.5	54.0	14.2
Hong Kong	6.3	65.0	6.5	70.0	6.4
Greece	6.1	68.0	5.7	81.0	7.5
Portugal	5.7	62.0	4.7	62.0	1.7
Spain	5.3	68.0	1.8	87.0	1.2
Yugoslavia	5.2	62.0	4.7	77.0	16.7
Brazil	4.9	57.0	3.0	61.0	8.6
Israel	4.6	69.0	2.0	n.a.	n.a.
Thailand	4.5	51.0	9.5	68.0	43.5
Tunisia	4.3	48.0	−0.5	16.0	−23.8
Average: Top 12	5.7	61.0	5.6	64.7	12.0
Average: All countries	2.4	48.0	−0.0	37.6	−0.0

a Source: Hicks 1980 b Growth rate of real per capita GNP c Deviations from estimated values are derived from an equation where life expectancy in 1960 (LIEX) and adult literacy in 1960 (LIT) is related to per capita income in 1960 (Y) in the following way:

$$\text{LIEX} = 34.29 + 0.07679Y - 0.0000430Y^2 \quad R^2 = 0.66;$$
$$\text{LIT} = 9.23 + 0.1595Y - 0.0000658Y^2 \quad R^2 = 0.44$$

data must exist for all countries for all variables. His findings contradict Hicks's somewhat in that he does not find a strong association between the life expectancy or nutrition variables and growth. Rather, he supports the strong influence of changes in literacy on changes in output, and finds an important influence for literacy in reducing fertility. This finding supports the work of Cochrane (1980) and others who generally find that education and fertility reductions work together, but the evidence here is not always clear. Cochrane's work, for example, also suggests that in some instances, increased education at lower levels increases fertility, probably because of the effects of improved health and hygienic practices that cor[illegible] with increased education.

Wheeler's work has been extended by Marris (1982). Using data from 60 developing countries for the period 1965 to 1979, he estimated a model that confirms the previous findings on the importance of education for growth in developing countries. Furthermore, he found a relatively weak role for investment, as normally measured in terms of the construction of fixed tangible assets. The estimated cost–benefit ratios for education (measured by primary enrollment rate) ranged in his model between 3.4 and 7.4, depending on one's assumptions on costs. By contrast, the cost–benefit ratios for investments in nonhuman capital ranged between 0.4 and 1.0.

Finally, some mention needs to be made of some of the microlevel work on the influence of education. These studies are important, because they can more directly associate education differences at the worker level with variations in worker productivity. The study by Lockheed et al. (1980) has already been mentioned. Similar studies for more advanced countries also come to similar conclusions. In the United States, for instance, agriculture, studies by Griliches (1964) and Welch (1970) suggest that a 10 percent increase in farmer education raises productivity by 3 to 5 percent, compared to only a 1 to 2 percent increase to be gained from a 10 percent increase in either land, fertilizer, or machinery. In a classic study of the Japanese textile industry, Saxonhouse (1977) found that in the period between 1891 and 1935 improvements in productivity occurred almost entirely because of modest changes in labor force characteristics and working conditions. He concluded that the standard production function which examines only the conventional inputs of capital and labor, and the rate of substitution between them, is deficient to the extent it ignores the nonconventional inputs of worker education, training, and experience.

4. Conclusion

The overall conclusion from the literature surveyed here suggests a strong positive relation between education and growth. But it must be immediately qualified by stating that education is broadly defined to include worker training and experience. Human capital, not merely education, is a critical element in the production function, and a major element in explaining differences in productivity and productivity growth between countries.

Furthermore, it is possible to have too much investment in education, just as it is possible to have too much investment in plant and machinery. The higher rates of return to education in developing countries attest to the thesis that investment in education makes most sense where the supply of educated manpower is relatively scarce, as it is in most developing countries. Furthermore, there appears to be even in these countries too much investment in higher education and too little in primary education, which appears to be clearly related to farmer productivity in these countries. Overinvestment in education also appears a potential problem in some of the developed countries, such as the United States, whose current enrollment rates for higher education (56 percent) are almost double those of Europe (see Table 1). Overinvestment of this type is a particular problem in countries which subsidize higher education, and where, as a consequence, the private returns to education are substantially higher than the social returns.

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Modernization and Education

D. B. Holsinger

Modernization research has long suffered from lack of a universal definition and agreement on the appropriate level of analysis. Most of the modernization literature has focused on the pannational, the social structural, and the communal. Beginning in the early 1960s, studies dealing with psychological or individual modernization grew in number and in methodological sophistication. At the center of this later effort lay a concern to discover whether "modern man" was an empirically verifiable entity or merely a theoretically derived abstraction.

When viewed at the level of the nation–state, modernization has come to take on a widely shared general definition perhaps best stated by Levy (1966) as an increase in the ratio of inanimate to animate sources of power and the use of tools to multiply the effect of power. This is of course a process, as implied by the notion of change inherent in the word "increase." So for many social scientists and historians, modernization is understood as a process in which societies are transformed under the impact of inanimate technologies as applied to the solution of human problems. These changes most typically would be thought to occur across a broad spectrum of social structures—political, economic, and demographic—and would extend even to changes in the personalities of a national citizenry.

To some degree it is possible to see in the research literature on modernization the distinctive theoretical stamp of the several social-science disciplines whose adherents have turned their attention to the causes and consequences of the social change they have called modernization. Economists see modernization in terms of the application of technology to the control of resources in order to produce growth in per-capita production and consequent economic growth or development. Sociologists have for the most part concerned themselves with the process of social differentiation that characterizes a society as it moves to ever-increasing levels of inanimate power. They observe and describe new structures with new functions and old structures with changing functions. They might describe changes in the occupational structure and the rise in the interdependence of roles accompanied by an inexorable move to specialization.

Demographers and other students of human population have described modernization in terms of the patterns of settlement that accompany urbanization and the impact on population size, growth, density, and distribution of changing patterns in health care, hygiene, sanitation, and medicine.

Political scientists have concerned themselves with aspects of government and nation building during the process of modernization and, in some cases, have defined it in terms of the extent to which a society has developed the ability to adapt to change—how power is shared, how legitimization is achieved, how extensive a sense of national identification is and so on.

Historians such as Black (1966) have produced theoretical models of modernization through which, they assert, most nations have passed or are passing. It is not argued that all nations must move along this path and distinctive patterns have been noted. However, more recently, some students of modernization have written of the convergence of societies as they move from the uniqueness produced by centuries of relative separation and isolation into an era characterized by growing commonality. Thus an emerging world social structure is described.

New scholarship on modernization has not only become more specialized as the several social-science disciplines have applied their respective theoretical paradigms to its study, but it has also become more explicitly comparative and rigorously empirical. Studies outside Western Europe and the United States have permitted the scrutiny of countries at many stages of modernization and have led to the revision of many cherished notions of a single linear modernization sequence. However, despite its having become more empirical, universalistic, and specialized, the study of modernization has not produced a generic definition nor a coherent general theory that could become the basis for informing public policy interested in fostering social change.

Some have suggested that the starting point of any definition of modernization is not in the nature of societies but in the characteristics of the people who populate them. Thus, certain attitudes and values, or dispo-

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Consumption and Other Benefits of Education

W. W. McMahon

The consumption benefits of education are regarded here as the nonmonetary returns accruing from education to the individual throughout his or her life cycle. As such, they include not only the nonmonetary satisfactions enjoyed by the student while in school, but also the contribution made by education to the efficiency of household production of final consumer satisfactions during leisure-time hours before and after retirement, plus the contribution made by homemakers during the nonmarket time spent in household management and child rearing.

Many of these consumption benefits have been measured in a vast outpouring of recent research. This research has largely followed the lament by Schultz (1967 p. 300) in surveying the earlier literature that "all these studies omit the consumption value of education . . . It is a serious omission . . . The available estimates of earnings from education in this respect all underestimate the real value of education." The most fruitful empirical results have been achieved by use of the theory of household production as developed primarily by Becker (1975 pp. 67-68, 1976 Chap. 7) and as extended and recently surveyed by Michael (1972, 1982). The results of recent research, which are summarized below, find that education makes positive contributions to many types of nonmarket activities involving significant cognitive or education-related affective attributes, activities such as maintaining the health of family members, earning a higher rate of return on savings, improving the children's school achievement and preschool IQ, increasing the efficiency of household purchasing, and staying out of jail. Some studies find education counterproductive for the more mundane household (and workforce) tasks, inducing time to be shifted away from those tasks where education contributes less to productivity, such as dishwashing, mending, ironing, and the more time-intensive aspects of child rearing. For example, the findings of Lemennicier (1978) and Levy-Garboua and Jarousse (1978) are analogous to similar counterproductive effects found for comparable time-intensive tasks in the work place by Rumberger (1981) and others.

The following material focuses on those studies that control in some way for the purely market benefits of education to avoid double counting the satisfactions secured through the use of education in the work place. This summary excludes nonmonetary satisfactions of the job (Duncan 1976), since these derive from the use of market time. The private consumption benefits from education considered below exclude externalities and spillover benefits which accrue to the society (or to other jurisdictions) above and beyond those that accrue to the individual. This article will also focus on those microeconomic studies that test for measurable nonmarket effects—there is some work on the macro level, however, by Eisner and Nebhut (1981), McMahon (1981), and Kendrick (1979) that expands imputed values in the national income and product accounts to include an imputed value for the services of the education of homemakers in total consumption and hence in total product and total productivity.

1. Consumption Benefits

Consumption benefits of education can be regarded as those that fall within the "new theory of consumer behavior," even though most occur later in the life cycle and therefore can alternatively be viewed as a nonmonetary return on an investment. Higher earnings are a pure investment return, however, and hence are considered separately under investment returns (Psacharopoulos 1973) and under expected rates of return to education (McMahon and Wagner 1982). In considering consumption benefits, those studies will not be included that do not eliminate the benefits from education due to higher earnings.

1.1 Pure Current Consumption Effects

There are the current satisfactions enjoyed when schooling itself is enjoyable—particularly at high-school and college levels and in leisure-time courses—plus current services provided by local schools to the family such as hot lunches, community center services, and child care. Although these can be observed, little has been done to measure them beyond one study by Lazear (1977) and aspects of some cost-benefit studies of day-care services by Gustafson (1978) and others.

1.2 Health

There is strong evidence that education contributes to better health. Numerous studies show that education is highly correlated with good health, and highly significant work by Grossman (1976) considerably refines this. He controls for the individual's income, IQ, health status as a teenager, and wife's schooling, to find an effect of education on health status by age 46 that is about 40 percent as strong as the effect of education on wages. He finds that the wife's schooling has an even bigger positive effect on the man's health than does his own schooling. Those with more education live longer; each additional year of schooling lowers the probability of death by 0.4 percentage points. Lando (1975) finds less work disability, and in a later study Grossman, again holding income and other factors constant, finds that the children of more educated women tend to have healthier teeth, are less likely to be anemic, and are less likely to be obese. Although the positive effects of schooling on the individual's own health, of the wife's schooling on her husband's health, and of the woman's education on the health of her children are now well-documented, nobody yet has studied the effect of the education of the husband on his wife's health.

1.3 Effects on Further Learning

Leibowitz (1974), using Ben-Porath's well-known model of the household production of human capital over time, finds that a mother's education and preschool home investments in children significantly raise the child's IQ. Benson (1982) finds that families of high socioeconomic status tend to limit TV viewing and pay more attention to whether or not the child does his homework, factors positively related to school achievement. The number of years of college planned by white male and by black male college freshmen has been found by McMahon (1976, p. 322), after controlling for family income, ability, and all financial aids, to be positively influenced by the education of the parents.

Ben-Porath neutrality implies that the young person's past education *is* productive in further education as every school admissions officer knows, but also that this is only at the cost of its equal productivity in the market. This is not an issue when considering the productivity of education in the home during leisure-time hours, however (since in this case there are no forgone earnings), or when considering how the education of the parents contributes to the further education of the child in exchanges within the family.

1.4 Returns on Savings

Solomon (1975) finds that the level of education among respondents in a survey of members of the Consumers Union, after controlling for income and occupation, has the strongest relation to choosing the best inflation hedge for their savings.

1.5 Consumption Behavior

Michael (1972, 1982) finds that those consumers with higher levels of education shift their spending patterns among consumption items, behaving as if they have more real income (over and above the higher money earnings that they also have). He estimates this real income effect of schooling on nonmarket production of consumption satisfaction to have an elasticity of 0.5, an effect about 60 percent as great as the comparable relation of schooling to money earnings.

1.6 Expected Consumption Benefits

These appear, in preliminary evidence, to average 50–60 percent of the monetary returns *expected* by students from their higher education. When 5,000 students were each asked to appraise the value of the nonmonetary leisure-time returns to them, relative to the expected monetary returns, McMahon (1974) finds that students in fields like music placed the expected nonmonetary returns above the expected monetary returns, and those in medicine and business tended to place them at far less. McMahon (1984) also finds that expected earnings tend to have relatively stronger influence on most student and family educational investment decisions, an influence that is even more pronounced at the more advanced levels.

Within the sphere of nonmarket behavior, however, education is more productive in some household activities than in others. Lemennicier (1978) challenges Michael's important simplifying assumption that education is technologically neutral among these activities—an assumption that eventually had to be challenged—which allows schooling to affect the relative price of time within the household. He finds that this causes time to be shifted away from those types of activities which are time-intensive, so that in these activities education is counterproductive. He finds, for example, that a very large proportion of the time budgets of French housewives is occupied by dishwashing, and although he agrees with the positive effects of education on health, schooling, and saving behavior, which require cognitive and affective skills, the overall shifts away from dishwashing, mending, ironing, and analogous activities in the time budgets of the more educated French housewives leads him to conclude that education is counterproductive in these forms of household production. This is consistent with the now numerous research studies by Gustafson (1978), Levy-Garboua and Jarousse (1978), Ferber and McMahon (1979), and others documenting the time shifts of the more educated women in Sweden, France, and the United States toward entry into the labor force.

1.7 Home Management

The simultaneous technological revolution within the home, however, may require even less time-intensive labor and increasing levels of education for effective home management using fewer hours. The rapid swing to dishwashers, automatic washing machines, wash-and-wear clothing, and monthly bill paying by check require less time than the earlier methods. But they do require knowledge of home repairs and repair management, plus some accounting skills. Tele-shopping for groceries and sundries is now in use in 217 United States cities, tele-bill-paying and tele-banking are spreading, and home computers are now available at increasingly reasonable cost for managing household energy use, adjusting savings portfolios, teaching the children, doing the income tax, and even life-cycle planning—

all requiring more (and changing) education for their effective use.

There are many studies, not all accompanied by adequate controls for differences in money income, offering evidence that those with more education tend to adopt new products more quickly. Of those that do attempt to hold real income constant, Mandell (1972) finds that those with more education adopted credit cards faster; Michael (1982) reports on several studies including his own that indicate that more educated women are more likely to use contraception and to have fewer unplanned babies; and Hettich (1972) finds that more educated women are more efficient in market search, with potential savings as the result of more efficient purchasing behavior that raises the estimated rate of return to a college education by 1.5. percentage points. Nobody yet has studied whether or not persons with more education realize more of the deductions to which they are entitled on their income tax.

1.8 Affective Attributes Created By Education

As distinguished from the more cognitive attributes, these affect productivity in consumption in addition to their effect on earnings.

The clearest measures are of the comparative advantage schooling confers in the selection of a desirable spouse. Michael (1982) develops the point that one's own schooling and the schooling of one's mate are positively correlated by at least 0.4, making education a good investment in securing a spouse whose earning capacity and presumably other attributes are more desirable. The amount of college education planned by students is also found to be positively and significantly related to "finding a spouse with college values" in a study by McMahon (1984), who controls for expected monetary returns, as well as for financial aids and other influences on student decisions. It is interesting that the coefficient for this expected nonmonetary return is four times as large, and the t-statistic is twice as large, for men as it is for women students. Benham (1974) and Welch (1974) find that a wife's schooling raises her husband's annual earnings by about 3.5 percent.

Such affective returns from education as meeting and conversing with more interesting people, capacities for entertaining guests, and community service (although the latter is an external benefit discussed elsewhere) are recognized by students and expected to be positive, although only meeting more interesting people was found by McMahon to have significant effects on student decisions. Becker (1981 Chap. 4) suggests that schooling can contribute to greater happiness in marriage since it facilitates a more nearly optimal sorting among mates in the marriage market. But women with more education are also more prone to divorce, generating disutilities for the husband and children, a fact that Becker (1981 p. 231) and others have usually associated with the growth in women's earnings that lessen the economic advantages of marriage rather than with education per se.

Education facilitates readjustment for divorced persons with more education who are known to remarry more quickly. Also in the broader role stressed by Schultz (1975), it allows individuals to adapt more easily to changes on the job, disequilibria in the market, and new technology in the home. It also changes tastes—from drag racing or horse racing, for example, toward concerts and reading editorials. But the net effects of pure shifts in tastes on consumer satisfaction cancel out to some extent. Rather than concentrate on taste shifts, the research focusing on the effects on productivity in household production has been far more fruitful.

In summary, all this suggests that there are now many good studies offering evidence of positive consumption benefits of education—benefits (after holding earnings constant) to the family's health, schooling, return on savings, purchasing efficiency, home management skills, and affective sources of happiness. Against this, the counterproductive effects relating to divorce and to the time intensive activities in the home requiring less skill must be netted out. Beyond testing for additional effects, further work is needed such as extending the work by Michael and others using shadow prices to impute values (both positive and negative) to each of these nonmonetary benefits for individual families, and also for total consumption and total product at the macro level in the national income and product accounts. These would have to include the value of education in facilitating adjustment to disequilibria, whether they be caused by market opportunities, divorce, or new technology within the family.

2. Option Value in Education

The option value in education is the value of the opportunity to obtain further education, and hence to obtain the private and social benefits that this further education is expected to convey. The option value is above and beyond the direct value of education already completed for increasing monetary or nonmonetary returns—the option value for a high-school education, for example, is not the earnings of a high-school graduate but its value in permitting entry and success in college.

There are both monetary and nonmonetary values to the individual, and to the society, of keeping options for further training and future adaptability to changing conditions open. This entry will cover the value of the "financial option," as well as the nonmonetary "opportunity options." The latter include the opportunities for broadened employment choices, the opportunities for additional nonmonetary consumption satisfactions, and the opportunities for "hedging" against technical change. The direct monetary returns to education and the private consumption benefits are covered in separate articles, as are the external benefits—all closely related entries which the reader should see.

2.1 The Financial Option Value

The financial option return is the value of retaining an opportunity for increasing earnings later in life following the completion of further education. It depends, as do the other options, upon (a) the expected value of the schooling if it is obtained, and (b) the probability that it will be exercised. The option value therefore is very high at the primary-school levels, and diminishes as each additional level is attained. For example, as the highest level is completed, rising forgone earnings costs reduce its net value while the probability of going further also falls, so that at the last stage the option value approaches zero.

There is no double counting involved when the option value is added to the direct market value in valuing a given level of education. For example, as pointed out by Weisbrod (1964 p. 21), who has pioneered in this subject, the value of a high-school education by this approach is the sum of the high-school graduate's earnings over the life cycle (discounted back to their present value, of course), plus the value of the financial option of going to college. The latter is in effect an option "ticket" or discount for possible future use—if it is used to purchase a college education, the rate of return expected will be a function of its cost net of the discount.

Mincer (1963) has also pointed out that an increased amount of formal schooling is also associated with the financial option of getting increased amounts of on-the-job training. Mincer's work also develops the importance of these opportunities for on-the-job training and experience that builds on prior schooling (Mincer 1974). Both expected and realized rates of return to a college education that include this growth of earnings due in part to additional learning on the job are developed by McMahon and Geske (1982 Chap. 7) by race, sex, type of institution, degree level, and occupational field.

2.2 *Nonfinancial Options*

A "hedging" option is also provided by education, especially by a more general academic curriculum when it precedes specialization, that enables the individual to adjust more readily to changing job opportunities, as pointed out by Weisbrod (1964 p. 23). This has been referred to more recently by Schultz as the "value of the ability to deal with disequilibria." He generalizes it to deal not just with job changes, but also with the readjustments that must be made in all market and nonmarket behavior, the adaptation to technical change, and external benefits. Although more general education hedges against uncertainty, investment in specialized human capital still involves risk, as pointed out by Levhari and Weiss (1974), who also conclude that an increase in uncertainty per se can reduce the amount invested, and that the effect of uncertainty about returns can have ambiguous effects on the investment decision. This line of reasoning suggests that increased uncertainty may encourage shifts away from vocationally overspecialized curricula, and "back to the basics" of a more general curriculum whose hedging option value is higher.

Other options for nonmonetary returns from further education parallel the kinds of private consumption benefits of education and externalities in education that are discussed under those entries. For example, there is the opportunity available through further education of securing jobs that include some nonmonetary satisfactions such as those connected with being a college professor, as noted by Cohn (1979 p. 36), a minister, or a musician. These include not only a degree of flexibility and freedom in work, but also the stimulation of ideas and art while relating to people, and so on. During nonmarket and leisure hours, the range of options available in life-style, in security, and for other family members is widened. Weisbrod (1964) mentioned some minor examples of contributions to home production, such as filling out one's own income tax returns (valued at about US$700 million in fees saved in 1982 dollars), typewriting, and driving, but new research on many more is discussed in the entry on the consumption benefits of education. Finally, there is the option value of the external benefits of education, such as greater adaptability of the work force and contributions of education to the functioning of democracy and community life which have value from society's point of view.

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Externalities in Education

W. W. McMahon

The external benefits of education are those benefits to society that are above and beyond the private benefits realized by the individual decision maker, that is, the student and the family. They are above and beyond both private monetary benefits, in the form of increased earnings due to education, and the private nonmonetary consumption benefits, both of which are captured by the decision maker and taken into account by him or her as the decision is made.

External benefits to others include, for example, those satisfactions of living in a society with functioning democratic institutions and their related freedoms, lower crime rates, more books, more newspapers, and more literature. The economy and the markets on which it depends function better when there is mathematical literacy, adaptability, and understanding. The increased earnings from education generate not only private benefits but also social benefits in the form of public goods paid for by these increased earnings, and also savings in public welfare costs. As a final illustration, research discoveries which depend on an educational base benefit persons other than the researcher, including future generations, in very substantial ways.

The survey of research on the external benefits and external costs of education which follows distinguishes these from the private monetary benefits of education and from the private (nonmonetary) consumption benefits of education, both of which are covered in separate entries . There are some external costs of education (e.g., smarter criminals) that are included in this survey, but they are frequently offset (e.g., smarter criminals but much lower crime rates), and hence relatively less important.

1. Research on Externalities in Education

There has been a remarkable amount of new research that seeks to measure specific types of external benefits of education. Much needs to be done however before more comprehensive measures of the value of these external benefits is available. It is a huge task, making use of shadow pricing and techniques for imputation that seek to estimate both the direct effects (e.g., better health) and then imputing the value of the benefits and/or the savings in costs (e.g., reduced medical costs), going beyond the taxonomy that has characterized the earlier stages of inquiry. It is the observation of external benefits, however, including observation by the reader, and not necessarily their measurement, that is crucial from an epistemological point of view to establish their existence.

Nevertheless, measurement does help. Great care is required, first, to avoid double counting. What appears to be an external benefit may sometimes be a private benefit for the student or the family. Purely distributional effects also must be eliminated—if some nonstudents gain at the expense of others, the net external benefits may be negligible.

A second caution when it comes to measurement is that the worst errors appear to be errors of omission. Some writers merely ignore external benefits. If their existence is admitted, and they are appraised to be positive and substantial, it then follows on purely efficiency grounds that there must be public tax support for education and/or other market corrections if economic efficiency within the system is to be attained. That is, unaided private decision makers who cannot capture external benefits will cause the quantity and quality of education produced to be too small, and Pareto optimality will not be attained.

The basic voting model which allows voters to observe these external benefits and to respond by voting public support to secure them was developed by Howard R. Bowen (1943), who has continued to be a leader in the identification and analysis of external benefits in education (Bowen 1971, 1977, 1980). Weisbrod (1962, 1964) has also pioneered in this field. There has since been a vast amount of new research seeking to measure specific benefits, the main lines of which are surveyed below under the main headings of benefits to society as a whole, and benefits within the neighborhood and workplace. The benefits of education per se to other family members are omitted here because the family rather than the student, especially at younger ages, is regarded as the basic decision unit. From this point of view they are not externalities, but private consumption benefits of education. Equity considerations also are not covered here. Equity is the other major basis for public support of both public and private education—for example, the provision of greater equality of educational opportunity for students coming from lower income families or students that are disadvantaged in other ways. Equity in educational finance is also discussed in a separate entry, and goes beyond purely efficiency considerations with which this entry is concerned (McMahon 1982, McMahon and Geske 1982 pp. 189–286).

2. *External Benefits to Society at Large from Education*

(a) *Necessary for effective democracy and democratic institutions.* Viewing education as the key to the preservation of democratic freedoms in government and other institutions, Thomas Jefferson felt that education should be the primary responsibility of the state, and sought to have governmental constitutions amended to that effect.

(b) *Important for efficient markets and the adaptation to technical change.* Schultz (1975 p. 843) refers to this as "the ability to deal successfully with economic disequilibria, which is enhanced by education, and . . . is one of the major benefits of education accruing to people in a modernizing economy." Some of these benefits of course are realized privately, but as markets function more honestly and respond to new technologies effectively others share in the benefits.

(c) *Lower crime rates and reduced penal system expense.* Spiegleman (1968) presents evidence that juveniles involved with education are less prone to commit juvenile crime. Webb (1977) finds a limited educational background among adult prison inmates, estimating the cost to society of deficiencies in their education at US$19.8 billion (1982 dollars) annually. Ehrlich (1975) finds a strong positive relation between inequalities in schooling, relative density of the poverty end of the family income distribution, and specific crimes against property. He stresses the inequalities in the distribution of schooling and training rather than their mean levels as related to the incidence of property and violent crimes. Finally, Phillips et al. (1972) show that labor market status, which is heavily influenced by education, is a sufficient factor to explain rising youth crime rates.

(d) *Lower welfare, medicaid, unemployment compensation, and public health costs.* Garfinkle and Haveman (1977 p. 53) find a strong negative relation between education of the head of the household and poverty status, with its associated welfare and medicaid costs. The value of the external benefits of education have not been estimated, however, in relation to the specific reduced costs for aid to dependent children, public housing, or medicaid. With respect to the effect of education on better health, a strong connection has been extensively documented by Lefocowitz (1973), Lando (1975), Orcutt et al. (1977), and Grossman (1982).

(e) *Reduced imperfections in capital markets.* Students with little collateral have limited capacity to borrow from banks to finance their own education without governmental guarantees of student loans and some interest rate subsidy. This rationale was developed by Hartman (1973) and is widely accepted—even by Freeman (1973) who has argued vigorously that there is "overeducation," partly by discounting the value of all other external benefits (Hartman 1973 pp. 322–27). There are some private benefits to the students involved

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here, but also some benefits to others in the form of reduced tax costs for education.

(f) *Public service in community and state agencies.* Every community and state has wide ranges of voluntary boards and commissions that benefit from the service of educated public spirited citizens. These include united fund campaigns, community development commissions, jury duty, family service agencies, hospital volunteers, community symphony boards, and many more. It seems most reasonable that many individuals display some altruism in their behavior, including charitable giving, which is being studied by Burton Weisbrod and others at the University of Wisconsin. Not all of this is purely self-serving; the services rendered and gifts in fact do benefit others. Political scientists have found that high-school and college graduates are more likely to participate in these kinds of community service activities, as well as political activities. Political activities can be purely self-serving of special interests, and in this case are not external benefits. McMahon (1984) has found that students do not weigh community service possibilities significantly in making their educational investment decisions, suggesting that they do not view them as private benefits.

(g) *Complementarities in production: Noneducational benefits.* Primary schools provide baby-sitting services to working mothers as a by-product of their educational activities, which Weisbrod (1962) has valued at US$5 billion per year reexpressed in 1982 dollars. Drivers' education benefits not only the drivers, but also others who gain from a lower accident rate. Poor children and farmers benefit from school lunch programs, and community groups such as the Boy Scouts benefit from the low-cost use of school facilities.

3. Neighborhood and Employment-related Benefits

There has been less research on imputing a value for many of these:

(a) Neighborhood children display more socially acceptable behavior norms and offer better peer-group experiences (Weisbrod 1962).

(b) School closings cause adverse neighborhood effects, on which there has been research in specific localities.

(c) Leadership in charting new courses for society can have positive effects such as environmental improvements cited by Bowen (1977), as well as other neighborhood effects such as the draft riots in the late 1960s.

(d) In the workplace, Berg and Freedman (1977) argue that "overeducation" can lead to frustration in mundane tasks. Others more recently have suggested that as these tasks are "robotized," the worker can shift to tasks where education is more productive (e.g., programming the robots). Weisbrod (1962) suggests that there are also offsetting external benefits in the workplace in that the productivity, flexibility, and adaptability of each member of the group enhances the productivity of other members.

4. Spillovers in Education

The spillovers in education are those benefits of education that spill over into other political jurisdictions, normally as the result of net out-migration. Spillovers are a type of externality, since they are a benefit that is not captured by the decision-making unit within which the educational process occurs.

Their significance is largely due to the allocative inefficiency that occurs as educational benefits, including the social welfare cost savings due to education, are lost to other localities through out-migration. The local decision-making unit that loses these benefits then is likely to spend less on education. Weisbrod (1964 p. 111) presents evidence that where there are spill-outs, less, in fact, is spent. Financial aids to localities spill over some of the costs (Hirsch and Marcus 1969) to higher levels of government, thereby compensating at least in part for the Weisbrod underspending effect.

The spillovers considered below are geographical spillovers—both spill-outs and spill-ins—experienced by local school districts, by states (or provinces), and by nations. International spillovers in education are also very important. They have come to be known more popularly as the "brain drain," and are covered in a separate article in more detail.

4.1 Research on Spillovers in Education

Human capital, created by localities, has benefits that are lost to those localities when the individuals in whom the skills are embodied by education migrate to other localities and regions or nations, which in turn enjoy the benefits and cost savings.

4.1.1 Spillovers from Local School Units

The spill-outs from local school units to other localities and regions are larger, proportionately, than the migration between regions or between nations. Weisbrod (1964 p. 53) estimated, for example, that 87 percent of the males educated within a suburban school system near St. Louis in the United States migrated to other suburbs, to the urban center, or to other states and nations. The benefits to others comes in the form of a 21 percent increase in tax receipts as a result of the increased earnings due to education, of which 43 percent is a spillover to the federal government, 28 percent to the state, 14 percent to the county, 2 percent to the urban center, and only 12 percent is retained by the suburb. Even of this 12 percent that stays in the locality, 87 percent is eventually a spill-out to other localities through the high rate of out-migration. There are additional spill-outs in the form of reduced public sector welfare and social costs in the receiving community, including reduced costs of crime, reduced unemployment compensation costs, and reduced remedial education costs, including benefits even to the armed forces. Weisbrod (1964 p. 92) estimates the reduced unemployment compensation costs alone due to the education in one school district to be US$2,083,000 (when reexpressed in 1982 dollars), 87 percent or more of which is lost to other communities. The externality-type nonmonetary benefits, such as knowledge of and commitment to the institutions of a democratic society, also spill over and benefit other communities.

The spill-outs must of course be netted against the spill-ins. But for most communities these are by no means equal. Even if they were, the uncompensated community providing the education originally would still have an incentive to underspend if it lost most of its graduates and then in turn received replacements without cost. But replacements are not totally without cost, for if the underspending on education is too great, it is well-known that firms and families with education are less likely to migrate to these localities and the community will not grow (Heins 1976 pp. 14, 19). Although state aids and a desire to remain economically healthy both retard underspending, Weisbrod (1964 p. 111) finds in a multiple regression analysis that for each 1 percent net out-migration, communities spend (when converted to 1982 dollars) US$12.86 per pupil less on their local schools.

The implications for a national system of education have been addressed in Europe where the financing of educational systems is more centralized than in the highly decentralized system found in the United States. At a very early date, however, James (1911 p. 16) recognized these implications, remarking on "how many of our Western cities have grown strong because of the able and educated men who have come into them from the school districts of New England!" More recently, the rural to urban migration, and especially the migration of rural blacks from poor rural schools in the South or Puerto Rico to northern urban ghettos has caused a spillover of social costs due to unemployment, welfare, crime, and remedial education rooted in the inadequate education provided by the poor areas in the South that has been very noticeable. Hirsch et al. (1964) and Hirsch and Marcus (1969) have studied spillover benefits and spillover costs by constructing an input–output matrix that identifies the net effects further, and Flora (1974 p. 4 and Table 2) has estimated the net loss to rural districts in Kansas at 35–43 percent of their education expenditures. State aids to human capital-exporting localities, and national assistance that helps cover some of the social costs borne by communities receiving the less well-educated, are extensive in Europe, but less significant (and being cut back) in the United States, and even less extensive in most less developed countries (LDCs).

4.1.2 International Spillovers

International spillovers in education (brain drains) have long had and continue to have great significance. Migrations of human capital have been largely responsible, for example, for the transmission of the institutions of political democracy and of the Industrial Revolution from the classrooms and factories of England, and later from Germany and Scandinavia, to North America and to the other democracies of the Western world. Given the attraction of higher incomes, and the freedoms associated with these democratic institutions, the current emigration of highly trained manpower, including physicians, from poor to rich countries analyzed by Ballendorf (1972), Bernard (1971), and Winkler and Agarwal (1984) presents a very serious problem for less developed countries (LDCs) seeking economic development. A major role of the Berlin Wall and the rest of the wall between Eastern and Western Europe is to retard the loss of trained manpower through human capital spillovers. The spillovers when Fidel Castro exported the people from his jails to the United States in 1981, or the spillovers in education that have contributed to rapid economic development in Israel, offer additional examples.

A more restricted immigration policy that puts a premium on education for entry into the United States and Canada (e.g., the National Conference on Immigration Policy Report 1975), creates problems for economic development in the LDCs. If the Weisbrod effect (1964 p. 111) holds internationally, this could be expected to lead to less spending on education than would otherwise occur by the poor nations. The World Bank has assumed a very significant role in attempting to partially correct for the adverse effects of some of these international spillovers in education on the low income nations by aiding human capital development there. But changes in immigration policies and more widespread aid for human capital development in the LDCs would both contribute to allocative efficiency in the world and help reduce poverty.

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PART IV

Education and Employment

Education and the Labour Market

K. Hinchliffe

The several purposes of education have received differing emphases over time. Both as a consequence and a cause of the development of human capital theory, the weight given to the economic dimension of education has grown. Education has widely come to be seen as an aid to the achievement of individuals' economic ambitions and/or national economic and social objectives as determined by the state. This has been the case in educational debates in both the less developed countries (LDCs) and those developed countries where large numbers of young people and members of particular racial and social groups are unemployed.

The relationships between education and employment are many and cannot all be covered in one entry. Here the stress is on the educational characteristics of individuals and the characteristics of the jobs they enter (or fail to enter). In the first section, the evidence from both developed countries and less developed countries of the close associations between age, educational background, occupational status, and earnings from employment is very briefly described. How school leavers become absorbed into the occupational labour force is the subject of the second section, which discusses some of the many theories of the labour market and the role played by the public sector. Much of the controversy between different theories of labour markets centres around interpretations of the demand side. In the third section some brief comments are made concerning the supply of educated labour (or the demand for schooling) and the attempts which have been made to explain and predict this supply. Finally, some aspects of youth and school-leaver unemployment are discussed. While much of the debate on the issues in this section has been conducted in the context of the less developed countries, the recent increased levels of youth unemployment in the United States and Western Europe make it increasingly relevant there.

1. Age, Education, Occupation, Earnings

Education, occupational status, and earnings from employment have been shown in a wide range of studies to be positively associated in countries adopting many different types of socioeconomic system and at different levels of economic development. Earnings functions and path analyses of the effect of individuals' background characteristics on occupational attainment and earnings have invariably indicated that while much of the variance remains unexplained, the largest single indicator is education. Jencks et al. (1979) for instance, utilizing a considerable amount of data for men aged between 25 and 64 years in the United States, concluded that the number of years of education is the best single predictor of the eventual occupational status of a labour force entrant. The results of similar (but less sophisticated) studies in a number of less developed countri show the same findings, generally even more strongl Turning to earnings, Psacharopoulos (1975) has demonstrated that for the Organisation for Economic Cooperation and Development (OECD) countries, averag annual earnings of secondary- and primary-school leavers show a differential of 40 percent, while higher education graduates receive on average 77 percent mor than secondary-school leavers. In the less develope countries, the differentials are much wider (Hinchliff 1975).

Of interest to both individuals and the state is th relationship between the additional earnings associate with education and the cost of acquiring them. Thi is measured through rates of return arising from th resources used in education. International comparison of rates of return demonstrate, in particular, tw patterns: (a) returns are larger at lower levels o education, and (b) returns are larger in low-income tha in high-income countries. In addition, as a result of th significant elements of public subsidy in educationa provision, the net benefits to the individual ar invariably greater than the social ones. This is particularly marked in low-income countries at the highe levels of education.

Empirical studies of the interrelationships between education and earnings have usually included a third variable, age. Age–earnings profiles demonstrate that for all educational levels, earnings rise with age up to a maximum and then level off. Further, the higher the educational level, the steeper the rise in earnings. The result, for both developed and less developed countries, is that while average earnings in wage employment vary significantly by educational level for all age groups, they do so most prominently in the older age group. Another general finding is that the distribution of earnings at each educational level is wider for older workers, particularly for those with higher education. Finally, increments of age and education also appear to have different effects depending on type of occupation, with both being larger for professional than for manual workers.

Earnings functions and rates of return on educational investment which have been calculated in the less developed countries have largely been restricted to observations of individuals in the formal wage sector. While this sector is the one entered by the majority of those with higher levels of education, the rural and urban informal sectors still contain most of the labour force, and even most recent school leavers, in many countries. Detailed studies of the relationship between education and earnings in these sectors are few. A recent review of 18 surveys in 13 countries relating the educational level of farmers to their productivity, however, has suggested that four years of schooling may be capable of increasing productivity by around 10 percent a year (Lockheed et al. 1980). Surveys of urban informal sector workers in, for instance, Nigeria and Colombia have similarly demonstrated a positive association between education and earnings. Such studies, however, have usually omitted consideration of other possible earnings-related factors.

Summarizing, the large amount of empirical investigation into the relationships between education, occupation, and earnings from employment which have been conducted since the 1960s in both high- and low-income countries have resulted in two major findings. The first of these is that the main criteria used by employers to recruit new entrants into the occupational structure are level and type of education. To formalize this, minimum educational entry requirements are generally set for each occupation. Second, there is a very close correlation between an individual's educational attainment and his or her level of lifetime earnings. Explanations of these observations, however, vary widely. Each is based on a different theory of the operation of labour markets.

2. Education and the Labour Market

Explanations of the interface between individuals with specific educational characteristics and the nature of the jobs they enter are each one part of more general theories of labour markets. In this section, the different interpretations of the empirical conclusions presented above are discussed.

Three major approaches may be identified. First there is an approach grounded on the argument that the educational system itself operates in such a way that it directly adds to an individual's cognitive abilities. These abilities range from basic numeracy and literacy at one end of the scale to a greater capacity for logical and analytical reasoning at the other. These increased abilities lead to higher individual earnings. A second approach also maintains that schools are effective in changing a person but that the important changes are not those of cognitive abilities. Class background is here seen as the major determinant of occupation and income and the educational system is said to operate in such a way that it develops different sets of productivity-related personality traits among children from different social classes. This both legitimizes the distribution of jobs, which simply perpetuates the existing structure of social class, and also increases the productivity of all classes in their ascribed occupations. Traits produced by schools in those individuals who will fill low-paying jobs include punctuality, obedience, and respect for authority, while those for high-status occupations include self-reliance and the ability to make decisions. Finally, there is a set of approaches which directly questions the view that through the development of either cognitive abilities or personality traits, schools increase the potential productivity of individuals. Rather, the educational system is said to act simply as a selection mechanism to sort out those who possess nonschool-related characteristics, such as intelligence and motivation, which are in some way connected to productivity. Schooling itself does not affect productivity.

These views of education are further discussed below in the context of the wider labour market theories to which they are related.

2.1 Neoclassical Theory

In orthodox neoclassical economics the theory of the labour market is based on the marginal productivity theory of demand, reflecting the profit-maximizing behaviour of employers, a supply theory based on the utility maximization of workers, and the notion of competitive equilibrium. Following on from the composition of demand for goods, individual firms derive a demand schedule for labour (relating amounts of labour demanded to different wages) and labour is employed up to the point where marginal productivity is equal to the industry wage. In early models, labour was regarded as homogeneous. With the development of human capital theory homogeneity is no longer assumed and labour demand has come to be interpreted in a set of markets each with a demand for specific productivity determining worker characteristics, with education and training being the most important. In response to these, individuals are assumed to compare the costs of acquiring the relevant characteristics with the increase in earnings which they can expect from them. As a result of these comparisons individuals invest in themselves and the aggregation of these decisions determines the supply of human capital. If the demand for productivity-determining characteristics exceeds the supply at a given wage rate, this will then rise and in turn supply will increase and demand fall. Conversely if supply exceeds demand, the wage will fall and employment increase. According to human capital theory, then, the labour market is capable of continually absorbing workers with ever higher levels of education provided that education-specific earnings are flexible downwards and the labour market is a single continuous one. This approach to the operation of labour markets may be termed the wage competition model.

Since the early 1970s a wide range of labour market theories has been developed at variance with the orthodox neoclassical/human capital school. The theories have emerged largely in response to a number of empirical observations of the United States labour market, which have been said to be at odds with the implications of orthodox theory. These include the persistence of poverty and income inequality, the failure of education and training programmes to raise the incomes of the poorest groups, continual upgrading of the qualifications required for jobs, continuing discrimination against sections of the labour force, and widespread worker alienation (Cain 1976). The interpretations of labour market functioning which have come to compete with orthodox theory may be divided into labour market

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segmentation and job competition models. Each of these contains variants and there is often a degree of overlapping between variants of all three theoretical approaches.

2.2 *Alternative Theories*

Segmentation models are discussed in detail elsewhere. Essentially it is argued in these models that the labour market is characterized by a number of segments, each of which has different conditions of employment and recruits from among separate sections of the labour force. To some theorists the types and number of jobs in each segment are determined by technological requirements; to others segmentation occurs as the result of conscious actions by capitalists to divide the working class and reduce class consciousness. The latter view has two implications for education. First, educational expansion among those groups consigned to the secondary labour markets characterized by low pay, insecurity, and poor working conditions will not lead to increased earnings. Second, this view links up with the approach to education described above, which argues that the role of the educational system in capitalist society is to reproduce existing class relations by legitimating the stability of intergenerational occupational status and developing different sets of personality traits among different groups in society necessary for a hierarchical occupational structure. The technological interpretation of segmented labour markets has features which tend to run into this rather conspiratorial approach but also shares some of the arguments associated with the job competition model, which is concentrated on in the remainder of this section.

The third view of education described earlier argues that schooling merely acts as a screening device which helps employers to choose between people who have very different capabilities and compete for a small number of jobs. In this view, educational credentials are essentially signals which indicate the varying levels of "raw" intelligence, motivation, and so on, which affect future productivity or "trainability". These credentials may accurately predict future work performance but they do not directly add to it. Several attempts have been made to describe in detail the interrelations between schooling and the labour market based on this simple concept of screening. One of the most widely discussed is the job competition model associated with Thurow and Lucas (1972) and developed by them to counter the wage competition view of the United States labour market.

The job competition model is based on the uncertainty which surrounds the hiring of labour. Given the problems of accurately predicting the future performance of job applicants and the fact that most job-specific skills are learned on the job, the employer uses educational qualifications as a proxy for those characteristics which facilitate training. In the model, two sets of factors determine an individual's income. One set determines the job structure in the economy and the other an individual's relative position in queue for jobs. Job structure is regarded as tec nologically determined and a central feature of th model is that productivity is seen as an attribute of job rather than of people. Consequently wages are bas on the characteristics of jobs rather than the chara teristics of people in them. Workers are distribut across job opportunities according to their position in the queue.

Potential workers come onto the labour market wi a variety of background characteristics, the most impor tant of which is amount of education. While these an insufficient to allow the worker to immediately perform in the production process, they do affect the cost o training, which is usually acquired formally or infor mally on the job. Potential workers are then ranked in a labour queue according to their expected training costs. Based on such a queue, jobs are distributed with employers offering high-productivity jobs to those at the head and working down. In contrast to the wage competition model, which sees the labour market as a market for matching demands and supplies of job skills, the job competition model sees it as a market for matching trainable individuals with training ladders.

Given the variations in skills required over the job structure, the amount of training will vary between jobs. Once a worker has landed a job and received the training to raise his or her productivity to that of the job, the time required for further training for a higher productivity job is likely to be less than that required for someone recruited from outside the firm. As a result, highly structured internal labour markets develop within the firm. As Blaug (1976) argues, it is the addition of the concept of internal labour markets to the simple screening effect of schooling which is used to counter those critics who argue that screening can account, at most, for education-related differentials in starting salaries but not for the often stronger correlation between schooling and earnings which continues through working life.

The theories of job competition and screening, in their various forms, have important implications for educational policy. As high-productivity jobs become scarce, competition to get to the head of the labour queue intensifies and the amount of education required increases. A leapfrogging process develops whereby the demand for education by individuals increases the more difficult it becomes for each education group to secure jobs. The effect of educational expansion is neither a fall in occupational wages nor an increase in jobs. What does result is that educational qualifications for jobs lower in the hierarchy rise and the more highly educated are then recruited to jobs that would have been filled in the past by the less educated. While the surplus of a particular ~~educated labour~~ group does not affect occupational wage levels, it does result in a lower average wage for the group. However, since the "bumping" process, once triggered, will extend right down the occupational ladder, wage differentials and hence the incentive to acquire further amounts of education may not decrease. However, if jobs are performed no differently by those with different levels of education, the social returns to this educational expansion are zero. If, on the other hand, all job entrants are not perfect substitutes in this sense and either levels of productivity within particular jobs can be affected by the individual or training costs do vary between individuals in line with their educational qualifications, the social returns to investment in education may be positive. In this case the returns result more from an occupation selection mechanism than from an increase in the quality of labour.

2.3 *The Public Sector*

The labour market theories into which the various views of education have been placed have been formulated essentially for analysing the labour markets of developed market economies. In the labour markets of the less developed countries there are two major differences. Employment in the formal wage sector is very much proportionately smaller and within this, the public sector has a more important place. It is this dominant role of the public sector in the less developed countries which has often been used in the argument that the job competition model is even more appropriate to use in these countries than the wage competition one. In virtually all less developed countries, the public sector is the largest single employer and for secondary-school leavers and above, the majority employer. Public sector employment is strongly sought not only for the level of wages offered—which while offering large differentials at the highest levels may be below those in the private sector—but also for the long-term security. Wage levels in the public sector are set administratively by commissions sitting every few years and the criteria adopted rarely allow supply factors much influence. The result tends to be inflexibility with respect to wage levels and differentials. In addition, in order to appear impartial and as a way of coping with the selection of recruits from a large number of potential applicants, emphasis tends to be predominantly placed on formal educational qualifications for recruitment. As a result of both these factors, the problem of surpluses of educated labour is not resolved by wage changes (as implied in the wage competition model), but is rather thrown back onto the educational system to solve by continuously expanding qualifications (as implied in the job competition model).

3. *The Demand for Schooling*

The job competition model and its variants offer rival interpretations of the demand side of the labour market to that offered by the human capital or wage competition school. They say little, however, that disagrees with the human capital interpretation of the supply side. Both wage and job competition models reject the earlier view of education as consumption and adopt the position that the demand for postcompulsory levels of education is related to the direct and indirect costs of that education and the earnings differentials associated with it. The notion that earnings forgone are perceived by potential students to be an important part of the private cost of education and that they make a careful assessment of future alternative earnings patterns before deciding whether or not to acquire more education is widely shared. According to Blaug (1976), the hypotheses resulting from this position come in two versions: first that total enrolments can be predicted by relating private costs to future expected benefits (i.e., by calculating expected rates of return) and second, more ambitious, that enrolments in specific fields of study can be predicted.

Despite the hypothesis that the demand for schooling can be predicted by private cost–benefit considerations being central to human capital theory and shared by many who criticize other aspects of the approach, Blaug has demonstrated that attempts to prove it have not been particularly successful. Early attempts made in the late 1960s to estimate the demand function for higher education in the United States tended to regress some measure of enrolments on household income and direct education costs while including neither forgone earnings nor measures of expected future earnings. In other words, the tests were more those of the consumption explanation. Later work turned away from total demand and towards the demand for specialized areas of study. Freeman's (1971) work on engineers and scientists is an example and one which appeared to bear out many of the predictions of human capital theory. A major drawback to this study, however, was the use made of starting salaries as a proxy for lifetime earnings, with the result that the hypothesis that students do take a life-cycle view of careers was not actually tested.

Problems of rigorously testing the demand for the schooling side of human capital theory in European countries have similarly been large, although more general explanations of the behaviour of demand for higher education along these lines have been plausible. For instance, the impressive rise in the age participation rates for higher education in the United Kingdom in the 1960s and their stability (and even fall) since the early 1970s have been plotted against changes in the availability of student grants, the fall in their value relative to the earnings of employed youth, and the fall in the ratio of graduates' starting salaries to the average wage. These types of explanations, however, remain at a rather general level. Turning to demand for specific subject areas, the rationing of higher education in Europe makes it almost impossible to test the extent to which subject choice is influenced by earnings. The major attempt to do this for the United Kingdom was unsuccessful (Klinov-Malul 1971).

While numerous surveys in both developed and less developed countries have concluded that the economic aspects of schooling are strongly considered by potential students and their families, the human capital hypothesis that it is possible to predict the strength of demand

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4. School-leaver Unemployment

Unemployment is one of the issues which has been given much attention since the early 1970s in the literature covering the less developed countries. Surveys of open unemployment (as opposed to underemployment) in these countries have generally shown that it is greater in urban than rural areas and that within urban areas it is more serious for females than males, for the 15-to-24 years age group than other age groups, and for the more educated, at least up to postsecondary education. In the early 1980s the world recession has also resulted in levels of unemployment in the developed countries higher than at any time since the peaks of the 1930s. Once again rates of unemployment are higher for females and for the 14-to-24 years age group. As overall unemployment has increased, its concentration among the young has intensified relative to other age groups. The relationship between unemployment and education in these countries, however, appears to be a straightforward negative one.

As an example of the nature of youth unemployment in the developed countries, Casson's (1979) study based on a labour force sample survey undertaken in European Economic Community (EEC) countries in 1973 and 1975 will be briefly described. Among the results of the survey were the following:

(a) Duration of search—while levels of unemployment are higher among the young, their duration of search is significantly shorter than for other age groups.

(b) First job seekers—the proportion of first job seekers among the unemployed is highest among young people and declines steadily with age: these proportions, however, vary considerably between countries, with around 40 percent of the unemployed under 18 years looking for their first job in the United Kingdom while in Italy the corresponding figure was 95 percent.

(c) Methods of job search—in those countries where public employment agencies are the major form of job search, young workers make below average use of them and rely more on direct enquiry; where employment agencies are less generally important there is little difference in frequency of use between the younger and older unemployed.

Turning to theories of youth unemployment, Casson argues that the statistical evidence supports the job search and school-leaver hypotheses. The job search hypothesis predicts that young people change jobs frequently, resign more commonly, and use informal procedures of job search. The school-leaver hypothesis is concerned mainly with unemployment during a recession. The predictions are that unemployment among school leavers will change in the same direction, but by a much greater amount than among the working population as a whole and that first job seekers constitute a high proportion of the young unemployed. The explanation behind these predictions is that other potential labour force entrants are much more flexible and find it easier to postpone entry to the labour market than do school leavers. As a recession deepens they withdraw whereas school leavers do not. Casson argues that the evidence does not support this explanation. On the one hand, the participation rate of adult women has continually increased, and on the other, the option of staying on at school has in general been taken. The results of a survey of employer attitudes towards younger and older recruits in the United Kingdom may be significant here. In all major respects apart from physical fitness, employers rated older recruits higher.

Turning to youth and school-leaver unemployment in the less developed countries, two features of labour supply dominate: the historically high growth of numbers and the increasing level of educational qualifications acquired by potential entrants. The annual average growth of the population between 1950 and 1970 in the less developed countries was 2.4 percent, three times that of today's developed countries in the nineteenth century. One result is that around 40 percent of the population is below the age of 15 years. The new labour force entrants are increasingly better educated as a result of rapid expansions in both primary and secondary enrolments since the 1960s. Not only, then, are new entrants more numerous than those retiring, they are better educated. Looked at in terms of jobs, while the required number of new jobs is increasing due to population growth, the quality of those jobs is also expected to increase. These combined pressures have been putting great stress on the labour markets, particularly in urban areas.

The most conspicuous feature of urban unemployment in less developed countries is that it is concentrated on the young with the ratio for the 15–24 years-age group often being over two and three times that for the total labour force. Given the age profile of unemployment and the recent expansion of education, it is not surprising that the unemployed tend to be relatively well-educated. While there are countries which do not fit the overall pattern, the available evidence appears to show a positive relation between levels of urban open unemployment and education up to the end of secondary school followed by a reduced level of unemployment among tertiary-level leavers (Squire 1981). This pattern also appears to correspond with variations in the duration of job search, a measure which is arguably more useful for identifying employment "problems" than unemployment rates.

Disagreements over the appropriate analytical treatment of school-leaver unemployment have tended to be sharp. Recently there has been a shift away from those who lay the blame on the schools themselves and on the antimanual work aspirations which they are said to produce through inappropriate curricula and teaching methods, towards a greater emphasis on the effect of wage differentials. Wide differentials are said to provide a rationale for extensive periods of job search particularly in countries where labour market information is poor. In this interpretation of school-leaver unemployment, alterations in school practices may be desirable but cannot in themselves result in altering school-leaver aspirations and eliminating unemployment. Unemployment is, then, regarded as a period of job search with its duration depending on the relative strength of three factors: (a) the higher the level of education an individual receives, the wider the variance of possible wage offers and therefore the longer the likely period of job search; (b) the higher the level of education an individual receives, the higher the opportunity cost through earnings forgone while unemployed and therefore the shorter the likely period of job search; (c) the greater the amount of financial support from the individual's family, the longer the period of job search.

The period of job search is seen as resulting in greater labour market information and a reduction in aspirations to a more "realistic" level.

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Work and Education

H. M. Levin

In most societies, education and work are intimately connected. Schooling is the main institutional experience shared by the young, while work is the principal institutional experience of adults. Most jobs and occupations have educational requirements for entry and advancement, and the organizational forms of schooling correspond closely with the organizational forms of work. Further, schooling attainments represent an important mechanism for determining social and occupational mobility from generation to generation. In many nations, schooling is even planned and assessed according to its contribution to meeting manpower needs and creating a productive labor force.

Although the term education is sometimes used interchangeably with schooling, it is important to note that schooling is not the only form of education. However, schooling represents such a dominant aspect of education in modern societies that the convention of equating education and schooling in the advanced industrialized societies will also be adopted here.

1. Correspondence Between Education and Work

Every society has specific forms of work which derive from the particular ways in which the society is organized. In traditional societies, adults must be able to produce directly the food, clothing, and shelter which they require for subsistence. In advanced industrial societies, adults must be able to function as workers in large and bureaucratic enterprises in which most jobs are unconnected with the production of daily needs and where work is broken down into highly routinized and repetitive tasks under a vast division of labor. The wages received for performing these tasks can then be used to acquire the necessities of life and any luxuries that can be afforded. In each situation, the societies can only reproduce their forms of work from generation to generation if the young are educated to perform in appropriate work roles by the time that they attain adult status.

Exposure to work tasks from an early age and placement in local work apprenticeships have been the dominant forms of preparation for work under preindustrial circumstances. Although schools existed prior to the Industrial Revolution, few children attended them and they were not crucial experiences for the world of work except for those who would enter the so-called learned professions of law, medicine, teaching, and the ministry.

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Expected Rates of Returns to Education

W. W. McMahon

The expected earnings and other returns expected from education over the life cycle when related to costs, as they are in expected rates of return, are of great interest primarily because of their strong influence on student and family decisions about the types and amount of education students seek to acquire. But if, in addition, expected net returns are a reasonably accurate predictor of actual net returns, then the expected rate of return is also a convenient, albeit somewhat incomplete, guide to educational budget and policy decisions designed to achieve social efficiency. In this case if individuals and educational institutions respond by investing more where the private and social expected rates of return are relatively high, the growth of per capita income is facilitated, as well as the growth of productivity and economic growth and development in the society in general.

The expected rate of return is a type of cost–benefit calculation that relates earnings that students expect to receive as the result of their education to educational costs. Specifically, it is that percentage rate of return that discounts the stream of earnings expected by the student (or by others) over his or her life cycle back to its present value and equates them to the total educational costs compounded forward to the date of graduation.

It is particularly useful for two reasons. First, it permits comparison of the relative return to widely different forms of investment, either in education or in physical capital or financial assets. Second, the rate of return is a widely understood concept, facilitating communication with the financial community and widely diverse fields within and outside of education. However, it also has its limitations. The major one is that the benefits from education that enter into the calculation are normally limited, to earnings, thereby excluding nonmonetary private returns and social benefit externalities. Since the latter nonmonetary returns should in principle be included, and are omitted only because they are hard to measure, the result is that the total expected returns to education will tend to be understated. The reader should see, however, summaries of the progress made in recent research in beginning to measure these nonmonetary private and social benefits under other entries in this Encyclopedia.

The remainder of this article will consider more specifically the relatively high degree of correspondence between expected and actual earnings and the basic methods of calculating expected rates of return. It will also consider the differences that exist among the expected rates of return to investment in different types of education (e.g., by occupational field, by degree level, and by type of institution) as well as differences in expected rates of return by race, sex, and among those few countries where studies thus far here have been done (United States, United Kingdom, Philippines, and Egypt). It will be suggested that the evidence that exists indicates that student and family expectations are not so myopic as might be supposed.

Consideration of the way in which student and family expectations actually are formed has implications for the debate between adaptive and rational expectations, as well as for educational policies that attempt to deal with problems of motivation, such as among black male high-school underachievers. In sum, the study of expected rates of return, as distinguished from manpower planning approaches, has considerable significance for the socially efficient operation of the relatively decentralized educational systems characteristic of most nations.

1. Measurement of Expected Rates of Return

To measure expected rates of return requires first that information be obtained from the student and perhaps also from the family on the earnings he or she expects to receive at future times over his or her life cycle. This data then can be used to estimate an entire age–earnings profile, similar to those shown in Fig. 1, for the level of

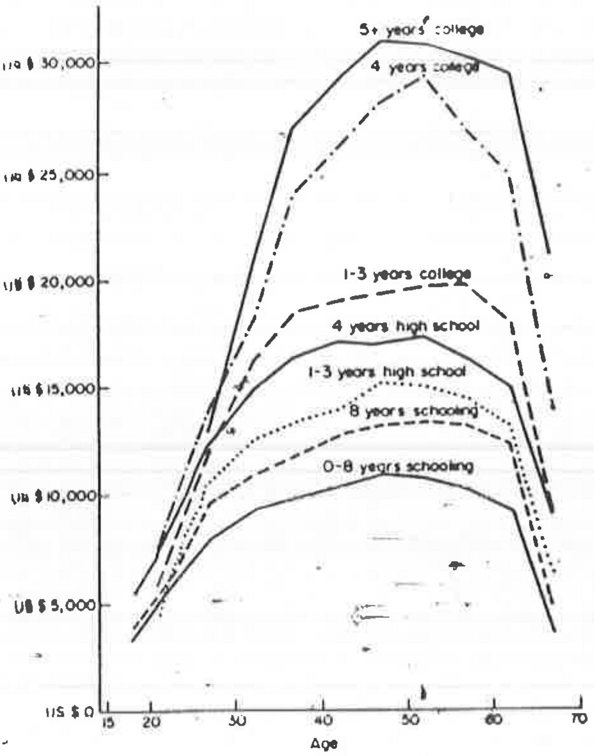

Figure 1
Age-earnings profiles of white males in March 1979[a]

[a] Source: US Bureau of the Census 1980 *Money Income of Families and Persons in the United States*. Current Population Reports, Series P60, No. 123

education the student attains. Before turning to the two main methods used for calculating expected rates of return it is important to consider some data for several countries on the earnings that students expect to receive at graduation and later in their life cycles in relation to actual earnings, since those enter in a major way into the calculation.

1.1 Expected Earnings and Actual Earnings

The earnings students in the United States expect to receive when they complete their formal schooling are compared with the earnings they expect to receive 25 years after completion of their bachelor's degree in Table 1. Students were asked to estimate their expected earnings in the absence of inflation (as for the expected rates of return reported for United States students below), based on a nationwide survey of 5,346 college students described in McMahon (1974 pp. 43–8, 167–79) and analyzed further in McMahon and Geske (1982 Chap. 7).

It is clear that both male and female students receiving bachelor's degrees in 1975 (at the top of Table 1) expect somewhat lower starting salaries than those who planned to finish master's degrees in 1976 or Ph.D.s in 1978. But all groups of students expect a higher rate of growth of earnings later in their life cycle upon completion of college training. Their mean expected salary 25 years hence not only reveals expected age–earnings profiles that are more peaked at each higher degree level, typical of the age–earnings patterns found the world around. But their expectations also compare very closely to the actual earnings patterns for college graduates shown in the United States census data toward the top of Fig. 1. This pattern of growth of actual earnings of college graduates in the United States has been sustained over a long period of time as reported in Table 2.

Similar patterns have been found in several other countries. There is a close correspondence of earnings expected at graduation with the actual earnings of those who have been in the labor force in the United Kingdom, as well as in the United States, as shown in Table 3. If the time is expanded to encompass the first five years after graduation, a reasonably close correspondence between expected and actual starting salaries have been found for the Philippines and Egypt as well. These data are from the only four studies of expected earnings and expected rates of return that have been made thus far. The United Kingdom data (and the United Kingdom expected rates of return discussed below) are from a sample of 2,944 high-school students who were planning higher education, as analyzed by Williams and Gordon (1981 pp. 202, 225–26). The Philippines data are from a nationwide sample of 9,105 college students collected by the International Institute for Educational Planning (IIEP) and analyzed by Psacharopoulos and Sanyal (1981b p. 451). Egyptian data are from a sample of 1,935 college students and 1,712 other college graduates, also collected by the International Institute for Educational Planning with the Supreme Council of Universities, and analyzed by Psacharopoulos and Sanyal (1981a p. 4).

The accuracy of students' expectations in the United Kingdom about earnings 25 years hence is also remarkable; males expect earnings to grow 2.47 fold, whereas the General Household Survey shows that actual earnings of graduates have grown 2.44 fold, for example. Expectations of earnings 5 and 10 years after graduation in both the Philippines and Egypt are overly optimistic (see Table 3). But expected inflation was not fully removed in these cases, and even at that, the rate of increase in expected earnings as shown in the last columns of Table 3 are not all that much greater than the percentage increases in actual earnings. Female expectations are somewhat optimistic in all countries including the United States in relation to the age–earnings profiles actually experienced. But opportunities have been improving for women in some nations (Ferber and McMahon 1979) and continuation of these improvements may be expected by students.

1.2 Method of Calculation of Expected Rates of Return

There are two basic methods for calculating the expected rates of return. The first uses the standard

Table 1
Expected starting and future salaries and growth in earnings[a]

	Mean expected starting salary[b]	Mean expected salary in 25 years	Ratio of earnings in 25 years to starting salary	Average annual expected real rate of growth in earnings[c]
		Bachelor's degree		
Male	$10,087 (2,792)	$18,005 (6,768)	1.78	3.56
White	10,084 (2,824)	18,038 (6,690)		3.58
Black	10,119 (2,493)	17,680 (7,603)		3.39
Female	8,457 (2,479)	14,192 (5,600)	1.67	3.08
White	8,367 (2,534)	14,054 (5,702)		3.08
Black	8,899 (2,152)	14,866 (5,070)		3.04
		Master's degree		
Male	10,346 (2,864)	20,367 (9,188)	1.97	4.84
White	10,278 (2,794)	19,235 (7,416)		4.35
Black	10,500 (3,024)	22,955 (11,942)	5.93	
Female	9,000 (2,566)	16,304 (6,643)	1.81	4.05
White	8,780 (2,507)	14,876 (5,127)		3.47
Black	9,346 (2,631)	18,548 (8,023)		4.92
		Doctor's degree		
Male	11,244 (5,181)	28,296 (22,581)	2.51	8.92
White	10,623 (4,685)	27,112 (25,104)		9.13
Black	12,884 (6,073)	31,422 (13,668)		8.46
Female	10,776 (4,529)	21,848 (16,062)	2.02	6.04
White	9,808 (4,029)	19,231 (16,555)		5.68
Black	12,523 (4,944)	26,568 (14,311)		6.59

a Source: McMahon and Wagner (1981, pp. 276–7) b Standard deviations are shown in parentheses below each entry c Annual real growth rate calculated from mean expected salary point estimates. Percentage increase from starting salary to future salary divided by number of intervening years: bachelor's 22 years; master's 20 years; doctor's 17 years

formula, widely understood in educational and in all other branches of finance for calculating a pure internal rate of return, whereas the second uses the first derivative of an expected-earnings function estimated by regression methods. Both involve using a smaller number of points to approximate the expected age–earnings profiles illustrated in Fig. 2 as $E_1(t)$, earnings expected at each age from graduation up to retirement. $E_0(t)$ measures forgone earnings prior to graduation, and $E_0(t)$ after graduation represents the earnings that could have been expected in the absence of the increment to education. For the expected rates of return, the two points of earnings expected at graduation (Y_0) and earnings expected 25 years hence near the peak of the

Table 2
Ratio of mean income of college to high-school graduates[a]

All workers		Year														
Ages	Midpoint	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Graduation	22															
25–34	30	1.33	1.32	1.33	1.33	1.27	1.22	1.19	1.15	1.19	1.26	1.21	1.24	1.22	1.27	1.32
35–44	40	1.53	1.47	1.58	1.54	1.55	1.55	1.52	1.55	1.56	1.55	1.48	1.47	1.52	1.48	1.42

a Source: Various issues of *Current Population Reports*. Series P-60, US Bureau of the Census

Table 3
Expected and actual earnings

	At graduation Y_0	After 5 years Y_5	After 25 years Y_{25}	Ratio Y_5/Y_0	Ratio Y_{25}/Y_0
United States (dollars)					
Males' expectations[a]	10,087		18,005		1.78
Females' expectations[a]	8,457		14,192		1.67
Actual starting salaries[b]	10,119	11,510	17,405	1.14	1.72
United Kingdom (pounds)					
Males' expectations[c]	2,100	3,371	5,199	1.60	2.47
Males' actual[d]	2,399		5,856		2.44
Females' expectations[c]	1,835	2,587	3,391	1.41	1.84
Females' actual[d]	2,161	2,894	3,193	1.34	1.47
Philippines (pesos)					
Males' expectations[e]	9,912	14,892		1.50	
Females' expectations[e]	6,756	16,380		2.42	
Actual earnings[f]	n.a.	7,992			
Egypt (Egyptian pounds)		Y_{10}		Y_{10}/Y_0	
Males' expectations[g]	564	1,512		2.7	
Males' actual[h]	252	654		2.6	
Females' expectations[g]	432	1,104		2.6	
Females' actual[h]	264	481		1.8	

Sources: a Table 1 b McMahon and Wagner (1981 p. 280 Col. 3) c Williams and Gordon (1981 p. 202) d Williams and Gordon (1981 pp. 225–26 Col. 1) Y_0 and Y_{25} found by interpolation for ages 20–24 and age 47 e Psacharopoulos and Sanyal (1981b p. 459), converted to annual basis f Psacharopoulos and Sanyal (1981b, p. 451 for salaries and p. 460 for Y_{10}) g Psacharopoulos and Sanyai (1981a p. 4) h Psacharopoulos and Sanyal (1981a p. 23). annual basis

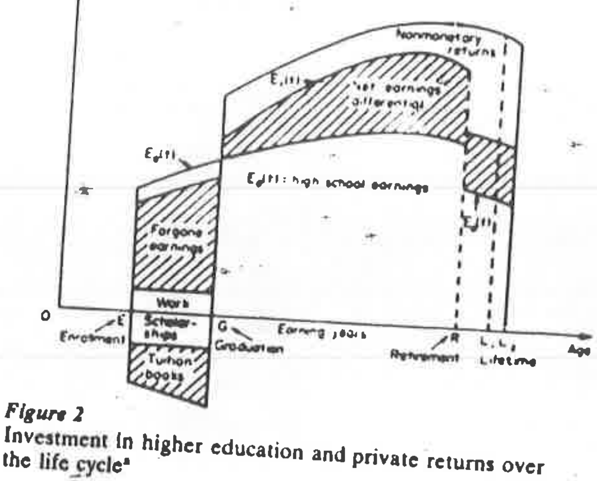

Figure 2
Investment in higher education and private returns over the life cycle[a]

[a] Source: McMahon and Wagner (1982)

age–earnings profile (Y_{25}) are used to determine the level of each age–earnings profile. Each profile is assumed to be the same shape as those observed in Fig. 1 to determine the values for all other years to calculate the "net earnings differential." Williams and Gordon (1981) use similar points (specifically Y_0, Y_5, and Y_{25}) for the United Kingdom, but assume that earnings rise linearly between these points to peak at Y_{25}, and then level off until retirement at age 65 to compute expected lifetime earnings. This then is used as the dependent variable in an expected earnings function.

The pure expected rate of return, r^*, is given by solving the following formula iteratively on the computer, using individual micro data for each student:

$$\sum_{t=E}^{G} [E_0(t) + C(t)] (1 + r^*)^t = \sum_{t=G}^{R} [E_1(t) - E_0(t)] (1 + r^*)^{-t} \qquad (1)$$

where the terms, as illustrated in Fig. 2, are $E_1(t) - E_0(t)$ = the expected net earnings differential attributable to the next higher level of education;

Table 4
Expected and realized social rates of return, US white male students, by occupation and degree objective[a]

	Degree level[b]				All degree levels	
Occupation	Associate	Bachelor's	Master's	Doctor's/ professional	Average expected	Realized
Health		16.1 (1.5)		11.1 (1.0)	12.7	7.2
Doctor, dentist				12.2 (0.8)	12.2	11.7
Health technician		9.1 (2.5)			9.4	
Pharmacist		20.1 (1.1)		3.9 (4.8)	15.2	12.4
Lawyer				15.5 (2.1)	15.5	14.1
Engineering–Technical	36.4 (8.0)	24.4 (2.2)	8.5 (0.7)	7.2 (0.8)	19.0	12.6
Architect		23.6 (2.3)	10.5 (1.6)		17.2	8.5
Engineer		18.9 (2.0)	10.0 (0.6)	7.4 (0.4)	14.1	11.0
Electrical technician	41.3 (4.1)	43.8 (1.0)			40.8	24.6
Business	22.1 (1.4)	17.1 (0.9)	10.4 (0.7)		15.9	11.3
Accountant	23.0 (1.1)	17.8 (1.5)	10.7 (1.2)		17.3	9.0
Manufacturing manager		16.0 (0.8)	10.8 (0.9)		13.2	15.2
Sales, retailing		16.6 (1.1)			15.5	12.4
Other Professional		7.6 (1.6)	7.8 (1.0)	1.4 (1.6)	6.5	3.7
Clergyman				−2.1 (3.6)	−2.8	−17.5
Natural scientist			7.4 (3.0)	3.2 (3.1)	9.4	7.7
Social scientist				−4.8 (4.5)	−4.1	8.0
Education		10.3 (1.6)	0.0 (1.6)	3.1 (2.0)	3.8	−2.8
Elementary and secondary teacher		10.3 (1.6)	−0.8 (1.6)	2.0 (3.0)	3.3	−3.8
College professor				5.2 (1.2)	7.6	5.5

a Source: McMahon and Geske (1982 Chap. 7) b Standard errors, computed as $s/\sqrt{n}$, are shown below each mean

$E_0(t)$ = the forgone earnings, or indirect costs; $C(t)$ = direct costs consisting of tuition and fees (if any), books, and special fees; r^* = the expected rate of return; t = age; $E, \ldots, G$ = beginning of education to graduation, for the level of education being evaluated; and R = retirement.

The "short-cut method" suggested and used, when appropriate, by Psacharopoulous (1980a) and by Psacharopoulous and Sanyal (1981a, 1981b) focuses on the net earnings differential at graduation, Eqn. (2a), or at the overtaking age 8 years after graduation, Eqn. (2b):

$$r^* = \frac{E_1 - E_0(G)}{\sum_{t=0}^{5} [E_0(t) + C(t)]}, \qquad (2a)$$

or

$$r^* = \frac{E_1(G+8) - E_0(G+8)}{\sum_{t=0}^{5} [E_0(t) + C(t)]} \qquad (2b)$$

This short cut has the strong advantage of being easy to calculate for approximate comparisons. But the authors recognize that Eqn. (2a) especially must be used with caution because the focus on initial earnings does not take into account the growth of earnings thereafter, and therefore underestimates pure rates of return. Starting salaries can even be below the earnings of high-school graduates whose steady growth of earnings on the job while others are in college precedes less growth later. Notice the close proximity in Fig. 1, for example, of earnings of 22-year-olds with high-school diplomas to those facing low starting salaries after college, compared to the potential for growth later. Starting salaries can be very erratic, especially in recessions, and can involve initial periods of unemployment, in relation to salaries at the overtaking age eight years later.

The second method in use for calculating expected rates of return is to estimate an earnings function of the type originally developed by Mincer (1974), or with variants that measure the school-leaving age differently as used by Williams and Gordon (1981, p. 218):

$$\ln E = \beta_1 s + \beta_2 s^2 + \beta_3 st + \beta_4 t + \beta_5 t^2 + \beta_6 A + u, \qquad (3)$$

where: $\ln E$ = log of annual expected earnings; s = number of years of schooling; t = number of years of experience on the job; A = ability test scores to control for differences in ability; and u = disturbances. The partial derivative of this function, $\delta \ln E / \delta s$, is then the expected rate of return to the last year of school—when t represents the overtaking age and therefore is set equal to approximately eight years of experience.

2. Differences in Expected Rates of Return

Using the first, more elaborate formula, expected rates of return vary widely by occupational field and degree level as shown in Table 4. The rates shown are expected social rates, including the full institutional cost specific to each student at each type of institution, which are more relevant to policy decisions and more practical for international comparisons.

2.1 Expected Rates of Return by Occupation and Degree Level

The lower expected rate of return at each higher degree level reading horizontally across Table 4 is a pattern typically found. It is caused primarily by higher forgone earnings costs at each successively higher degree level. Rising forgone earnings costs lower the rates of return, even though expected earnings are higher at each level, as was shown in Table 1. In another example of the effects of variation in costs on expected rates of return, the economies of scale in educational institutions in less developed countries (LDCs) (Psacharopoulos 1980b) and unemployment among the young and less skilled both operate to reduce direct and forgone earnings costs. If the later ages in the life cycle of expected earnings are taken into account, the effect of these lower out-of-pocket and opportunity costs is to raise expected rates of return, and hence to encourage expansion of investment in junior college and other post-secondary education.

The expected rates of return are averaged across all degree levels within each occupational field of study in column 5 of Table 4. They then can be compared with the actual rates of return as given by United States census data in column 6, and with expected rates of return by occupation in Egypt (and elsewhere) as in Table 5. The students' expected rates of return first can be seen to be quite accurate estimates of the actual rates of return for each degree field. The highest expected and actual rate of return fields are medicine, engineering, and business administration, with expected and actual rates of return that are all in the 12 to 15 percent range. The lowest expected rate of return fields are elementary education and the ministry (as well as music, which is not shown), falling in the low −17 to +3.3 percent range. There is evidence from studies using 1960 census data by Eckhaus et al. (1974 pp. 352-57) that similar patterns of differences in rates of return have tended to persist over relatively long periods of time. Since other studies find that students' choices are heavily influenced by differences in expected private monetary rates of return (Freeman 1971, Ferber and McMahon 1979, McMahon 1984), this persistence of different rates of return is most likely to be due in part to the limitations on entry imposed by some fields (e.g., medicine), combined with the relative ease of entry in

Table 5
Expected rates of return by field of study in Egypt, 1978[a]

Occupational field of study	Expected rate of return (%)
Medicine	17.2
Physical sciences	14.9
Architecture	20.3
Agronomy	15.3
Commerce	13.3
Veterinary medicine	13.0
Fine arts	12.2
Social sciences	11.8
Economics and politics	11.0
Overall	15.0

a Source: Psacharopoulos and Sanyal (1981a) other fields (e.g., primary and secondary education). It is also possible that there are larger expected psychic and social benefits in some fields, such as music and the ministry. If so, the true expected rates of return are understated in these fields in Tables 4 and 5, explaining persistence of some differences in the expected purely monetary rates.

The expected rates of return for Egypt shown in Table 5 reveal a very similar pattern. Again, medicine, architecture, and the physical sciences (the latter may include some of what is called engineering in the United States) are at the high end, in the 15 to 20 percent range. The relevance of education to agriculture and business administration are reflected in the medium to high expected rates of return for agronomy and commerce. At the lower end are several fields that may contain a number of prospective teachers, whereas in the United States expected monetary returns are lower.

2.2 *Expected Rates of Return by Sex and by Type of Institution*

When expected rates of return are compared internationally, as in Table 6, a remarkable similarity emerges among male students, especially at the bachelor's level. Females in all of the countries shown receive significantly lower earnings (e.g., 74 percent of male earnings in Egypt, 66 percent in the United Kingdom) which also lowers forgone earnings. The higher rates of return expected by females in the United States may be partly due to the increasing entry of women into more advanced degree programs, followed by employment in the high-earnings fields such as medicine, business administration, engineering, and law, as mentioned above.

Relatively little is known about how expected rates of return differ by type of institution. The only study that incorporates the specifics of private and total cost differences among institutions to calculate private and social expected rates of return is for the United States, and appears in McMahon and Geske (1982 Chap. 7 Tables 4 and 5). The conclusions reached there suggest first, that the terminal undergraduate degrees at the public comprehensive colleges and junior colleges where many undergraduate programs tend to be more vocationally oriented are very cost-effective. Expected private rates of return, for example, at the bachelor's degree level are never below 15 percent in any ability quartile, and average 21 percent across all ability quartiles. At the same time, the four-year liberal arts college and the public and private research universities are most cost-effective for those planning graduate work. At the master's and Ph.D. or professional-school levels, both the expected private and social rates of return for those planning advanced degrees are higher in these types of institutions.

These expected (and actual) rates of return are a much more comprehensive measure for use in comparisons than either the costs of education, or expected returns, taken alone. High-cost programs can be viable candidates for expansion if the expected returns are also high, and vice versa. There are now a number of excellent studies that document the wide variation in costs among institutions: Bowen (1980) develops the differences among higher educational institutions in the United States, Verry and Davies (1976) analyze the economies of scale by degree program and by institution in the United Kingdom, and Psacharopoulos (1980b) develops the major economies of scale in higher education to be found in international comparisons among many less developed countries. There is also a new but rapidly growing literature on educational cost differentials at the primary and secondary level (Chambers 1979 pp. 97–110, McMahon and Melton 1977).

Table 6
Expected social rates of return for several countries by sex and degree level (%)

	US[a] (1976)	England[b] (1977)	Philippines[c] (1977)	Egypt[d] (1978)
Upper secondary				
Male		2.16		
Female		11.7		
Higher education				
Males: Bachelor's	15.2	13.0	15.8	15.4
Master's	14.9	9.9	12.6	
Ph.D.	16.6		32.0	
Females: Bachelor's	37.2	9.9		14.5
Master's	30.4			
Ph.D.	21.6			

a Ferber and McMahon (1979 p. 416–17), using Eqn. (1) above b Williams and Gordon (1981 p. 219), using a variant of Eqn. (3) c Psacharopoulos and Sanyal (1981b pp. 468–69). This one column reports actual rates of return for all students, since the expected rates "must be downward biased as they are based on initial earnings" only. It uses Eqn. (2b) d Psacharopoulos and Sanyal (1981a p. 12), using Eqn. (2a)

3. The Formation of Expectations

Whether student expectations are formed by a cognitive process, as is emphasized by the rational expectations hypothesis, or as the result of experience as stressed by adaptive expectations, together with the realism of the resulting expectations, is of significance to educational and other policies designed to aid educational choices and to make labor markets work better. Although average student expectations may be reasonably close to actual job market outcomes as suggested above, there are changes in the job markets that may not be accurately anticipated, overly myopic expectations held by students coming from disadvantaged backgrounds, wider degrees of uncertainty in recession periods, and wider degrees of uncertainty among females, all of which affect behavior.

Economists have generally assumed in the past in theoretical and econometric models that income (and price) expectations are formed by an adaptive process. Friedman's permanent income hypothesis, for example, assumes that expected future income can be estimated by applying a distributed lag to immediate past incomes using geometrically declining weights. This gives the heaviest weight in the formation of expectations about the future to the most recent past experiences. Students of course do not normally have full-time earnings experience on which to base their expectations about the future growth of earnings but they observe what has happened within their families, to friends in their neighborhoods and school peer groups, to recent graduates, and to older friends of their families and teachers who may sometimes serve as role models. The rational expectations hypothesis has challenged this adaptive process, assuming instead that expectations are formed through a cognitive understanding of how the economy works and what the implications of policy changes are for job markets. Rational expectations are assumed to be subject only to random errors, and to become the basis for deliberate decisions. The dispute between these extremes cannot be settled here, but a more moderate view would suggest that there is some adaptive learning by the student of patterns and of what to expect, as well as some cognitive extrapolation of changes.

Empirical work over 30 years on the formation of expectations leads Katona (1980) to conclude that behavior is guided most commonly by repeated and rewarded past experience. This conditions expectations about the future and is consistent with a major stream of learning theory in psychology. He suggests that expectations about change add a "feeling tone that spreads over very many people and influences action . . . (whereas) the cognitive (rational expectations) content of expectations may be vague and may differ from person to person" (p. 33). Some adaptive effects are direct: high levels of unemployment among teenagers in 1981–83, for example, lowered opportunity costs and thereby raised the expected rate of return to education, maintaining enrollment in the junior colleges in these years in spite of the effects of falling birth rates. However, some job market changes may be cognitively perceived. The American College Testing Program in Iowa City and the College Entrance Examination Board in Princeton provide information to college and high-school counselors on both college costs and on starting salaries in many occupations in the United States (McMahon and Wagner 1981 Table 2). Data on the shape of age–earnings profiles as shown in Table 1 are now available from surveys and census data in many countries.

At the high-school level, Benson (McMahon and Geske 1982 Chap. 3) reports that both neighborhood experiences and the education or socioeconomic status of parents are significant influences on the students' use of time for study and hence presumably on their expectations about the future value of education.

3.1 Are Students Myopic?

It is only recently that student expectations have been studied empirically, and found to be fairly accurate with respect to the growth of earnings that students expect following further education. This was shown in Tables 1 and 2, as well as the earnings growth expected in engineering and other fields in addition to the traditional fields of law and medicine as shown in Table 4. There are significant empirical implications of the fact that students do not appear to be overly myopic, focusing only on starting salaries and on immediate job openings, but anticipate search time after graduation and regard cyclical declines in fields such as engineering as temporary. The controversial thesis of overinvestment in college education, for example, as advanced by Freeman (1975) depends on a myopic preoccupation with starting salaries by students, ignoring the lower opportunity costs of education during the worldwide recessions in 1974-75 and 1980-81 as well as the growth of earnings later in the life cycle.

A model stressing investment by the family, rather than only by the "independent student," stresses that the family's financial resources and the family's expectations as a group help to finance the high-school and college years of most students, and encourage the student's expectations to be less myopic (McMahon 1984).

3.2 The Uncertainty of Expected Earnings

Although analytically uncertainty can either increase investment in human capital as a hedge, or reduce it (Levhari and Weiss 1974, p. 956), there has been little empirical study of students' uncertainty about their future prospects. Table 7 suggests that females have a higher degree of uncertainty about their expected future earnings 25 years hence than do males as one might expect. Schultz (1971 p. 182) has postulated that those with lower ability may be more uncertain about their future prospects. But if anything Table 7 suggests that the higher ability males and females who have the higher

Table 7
Uncertainty about future earnings by sex and ability[a]
(1 = very uncertain, to 0 = very certain)

Ability level (ACT test scores)	Males Mean	Males (n)	Females Mean	Females (n)
All ability levels	0.46	1009	0.55	1668
22-highest	0.49	538	0.59	725
18–21	0.46	195	0.54	407
16–17	0.43	85	0.53	164
lowest-15	0.42	191	0.49	372

a Source: Questionnaires and survey as shown in McMahon (1974 Appendix A)

American College Testing (ACT) test scores are the ones that are more uncertain about their expected earnings.

No studies have yet been made of changes in the degree of student uncertainty, or shifts in the dispersion of student expectations over time, although Katona (1980 p. 33) suggests that these changes are relevant to other types of household saving and investment decisions.

In conclusion, expected rates of return appear to be more accurate than might be expected by occupational field, degree level, type of institution, sex, and length of the investment planning horizon. In the absence of accurate means of forecasting manpower needs, they provide a decentralized system with incomplete but useful guides to educational choices conducive to individual and social growth.

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Internal Migration and Education

R. H. Sabot

The spatial redistribution of labor which accompanies economic growth and structural change is observable both in individual countries over time and in different countries at varying levels of development. The decreasing share of total output from agriculture and the increasing share from manufacturing and services are associated with a decrease in the shares of the labor force in agriculture and rural areas, implying a net urban migration (Berry and Sabot 1978).

A strong positive relationship between the propensity of rural residents to migrate and their level of education has been observed in many countries at different levels of development (Todaro 1976). The educational selectivity of internal migration is due to the greater concentration in urban areas of the demand for skills acquired in school than of the supply of educational opportunities. Educational selectivity may be constant, but the educational level of migrants tends to increase over time. There are two reasons for this. On the one hand, the concentration of labor demand increases in skilled manual and white-collar occupations—a corollary of urbanization and the change in the sectoral composition of output that characterizes development. On the other hand, enrollment rates and the relative supply of educated labor rise—another regular feature of development (Chenery and Syrquin 1975).

1. Microdeterminants of Educational Selectivity: Theory and Evidence

From the perspective of the individual rural resident, education and migration both represent investments in human capital in the sense that both entail costs borne in anticipation of enjoying returns in the future. For investment in migration or education to occur, rural residents must expect monetary benefits (higher earnings) and nonmonetary benefits, appropriately discounted, to exceed the costs. Moreover, migration and education are complementary: investing in one enhances the returns to investment in the other, as illustrated in Fig. 1.

The income of rural workers who have just completed their formal education and begun to work is lower than that of uneducated workers, who have more experience as agricultural producers. Their greater training and natural ability, however, combined with better contacts with those in control of the supply of credit, enables the educated to use their resources more efficiently, to be more innovative, and thus to raise their income above that of the uneducated. Production functions relating the amount of farm output to the level of each input, including farmer's education, have been estimated in more than 10 countries at different levels of development. Though the results vary, the overall conclusion is that the productivity of small farmers with elementary education is substantially higher than the productivity of uneducated farmers (Jamison and Lau 1982). There are no studies of the effects of postprimary education on agricultural productivity, but the expectation, particularly in low- and middle-income countries, is that diminishing returns set in at low levels of education.

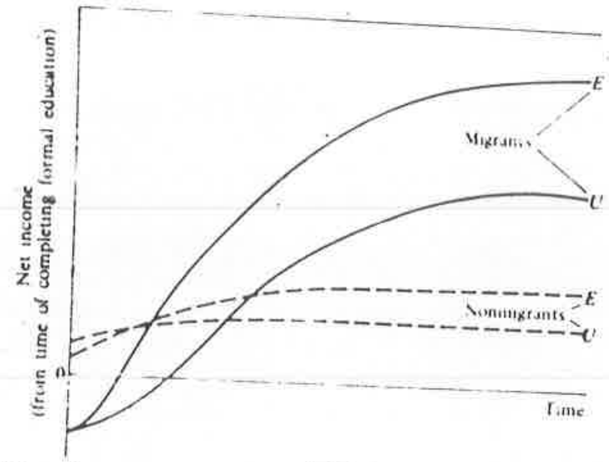

Figure 1
Earnings over time of educated (E) and uneducated (U) migrant and nonmigrant workers

The net income of migrants is negative at first, because direct costs of migration must be borne during the period of moving and searching for a job. Subsistence during the period of job seeking is likely to be the most important of these costs and to be positively related to the rate of urban unemployment. The income of the educated becomes positive before that of the uneducated. It also rises more steeply and to a higher level, reflections of the greater access of the educated to urban wage employment and the higher starting wages and returns to employment experience in the preferred occupations open to them. Earnings functions which relate wages of urban employees to various individual characteristics, including educational attainment, have been estimated in more than 40 countries (Psacharopoulos 1973). These functions indicate that a strong positive relationship between years of education and earnings is a universal characteristic of earnings structures.

Both rural and urban incomes rise with educational attainment. The evidence indicates, however, that the lifetime earnings of the educated are, as depicted in Fig. 1, higher in urban than in rural areas. For the educated rural resident the economic advantage of migration is thus more obvious; the present value of urban benefits dominates the rural stream. If the educated and the uneducated apply a similar discount to future income, expected net returns from migration will be higher for the educated. Because the educated are from higher income households for whom the costs of credit and the aversion to risk may be lower, the discount rate may be lower for the educated than for the noneducated, reinforcing the conclusion that the educated reap higher returns from migration.

Analysis of the relationship between migration rates and education is further complicated by the difficulty of separating economic from noneconomic costs and returns. The educational system may select individuals who are relatively open to change or who come from families having urban-oriented values on occupation and consumption. Alternatively, education may alter the preferences of rural residents, increasing their preference for urban jobs and an urban mode of living. Differences in the psychic costs and returns of migration to groups with different amounts of education may make educated rural residents more willing to move in response to a given economic return to migration. Of course, a higher rate of migration among the educated may be due both to movement along a migration function and to a shift in the function.

Though the behavioral analysis of migration is still in its infancy and there are as yet significant unresolved problems of data, measurement, and specification (Schultz 1982), migration functions estimated in more than 10 countries empirically confirm the forgoing propositions. Rates of migration for various geographic and demographic subgroups of the rural population are related to rural–urban income differentials, to probabilities of urban employment, and to distance. The sign on the destination wage elasticity is generally positive, that on the origin wage elasticity negative, confirming that rural residents respond to economic opportunities in their migration decisions (Yap 1977, Berry and Sabot 1978). Some studies have shown that extreme poverty may preclude investing in migration irrespective of expected returns, suggesting that the shape of the relationship between migration and source area incomes is an inverted U. In the few studies where such a determination is possible, it has been shown that higher rates of migration among the educated are due to higher economic returns and lower costs (Levy and Wadycki 1974, Barnum and Sabot 1977). It has also been demonstrated, controlling for economic costs and returns, that migration rates are still higher among the educated, lending support to the hypothesis that the educated have different preferences (Barnum and Sabot 1977).

2. *Suboptimality of the Rate and Composition of Migration Flows*

There is little doubt that internal migration and, in particular, the educational selectivity of migration are beneficial for economic growth. They contribute to the process whereby labor shifts from activities in which productivity is low to activities where productivity is high. This shift does not imply, however, that the rate or composition of migration flows is optimal. The premium earned by more educated urban employees may exceed the difference between more and less educated workers in productivity—as a consequence, for example, of government or union influence on wage structures and hiring rules. This implies that the gap between more and less educated rural residents in the private returns to migration exceeds the gap in social returns and that the educational selectivity of migration may be greater than is optimal for economic growth.

Growing urban unemployment among school leavers in developing countries may be a manifestation of above-optimal migration of the educated. The urban structure of wages may be slow to adjust to the increased supply of (migrant) school leavers that results from educational expansion. Rural school leavers may then be encouraged to migrate and wait for jobs in well-paid urban occupations rather than immediately accept a rural job that pays significantly less; if the income difference is high enough and the probability of obtaining a higher paid job is sufficiently large, a period of job seeking or unemployment will yield a higher expected lifetime income. This pattern is a variant of what has come to be known as the Todaro model (Todaro 1969).

Since the unemployed are young, have few dependents, and are often supported by their families, and since most of them eventually find jobs, neither the social nor the private costs associated with excess migration of this type are as serious as might appear (Berry and Sabot 1978). Moreover, the fact that some primary- and secondary-school leavers are unemployed does not imply that the economy is unable to make productive use of more of them. Various studies have shown that the social rate of return to investment in education may be high despite large numbers of educated unemployed (Psacharopoulos 1973).

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Immigrants' Economic Performance and Education

B. R. Chiswick

The economic performance of immigrants has been studied through analyses of earnings, employment, and occupational status. These studies have been done for several countries and in different time periods. They suggest that immigrants experience a decline in their occupational status at the time of immigration, but with

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a smaller effect on earnings than it does for the native born, and this is also true of labor market experience received in the country of origin. Their earnings in the United States rise more steeply with United States labor market experience than do the earnings of the native born. For the refugee populations that have been studied (primarily Cuban and Chinese immigrants) the effects of schooling on United States earnings are very small, and there is no effect of country of origin labor market experience on United States earnings. There is, however, a very sharp rise in earnings with duration of residence in the United States.

The earnings of immigrant men catch up with and then exceed those of the native born, other things being the same (Chiswick 1979). Male economic migrants initially have lower earnings than the native born. As a result of the steeper rise in earnings with United States experience their earnings reach those of native born (or native parentage) men of the same race or ethnic origin at about 11 to 15 years of residence in the United States, after which the immigrants have higher earnings. For example, in the 1970 census data white male immigrants in the United States reach earnings equality with the native born at about 13 years of residence, and those in the United States 20 years have earnings 6 percent higher than the native born. The earnings of black, Filipino, Japanese, and Mexican immigrants catch up with the earnings of the native born (or native parentage) of the same origin in the 11- to 15-year interval, after which the immigrants have higher earnings. For the two immigrant populations with the largest proportion of refugees, the Cuban and Chinese, earnings approach those of the native born, but do not equal or exceed them. The earnings of immigrants from developed countries exceed those from less developed countries, even when other things are the same.

It might seem curious that the earnings of economic migrants would eventually exceed those of the native born. With the passage of time in the destination the disadvantages of the less than perfect international transferability of skills diminish, and any remaining disadvantage may be dominated by the effects of the more favorable self-selection of economic migrants. This interpretation is strengthened by the finding that in the United States the sons of immigrants earn 5 to 10 percent more than the sons of native-born parents in the same racial and ethnic origin category. At least some of the favorable self-selection is passed on to the immigrants' children.

2.2 Employment and Investment in Education

Analyses of employment (weeks worked in a year) and unemployment emphasize the "new labor market entrant" characteristics of recent immigrants (Chiswick 1982). Very recent immigrants work fewer weeks and have higher unemployment rates than the native born, other things being the same. The differential narrows with duration of residence and essentially disappears after about five years of residence. The employment differential for new immigrants is larger for refugees than for economic migrants, and is larger during a recession than during a year of full employment.

These patterns reflect behavior that is also observed in the occupational status of immigrants (Chiswick 1978b). Using longitudinal data it has been found that there is a decline in the occupational status of immigrants when comparing the last occupation in the country of origin with the early occupation in the United States, but after entering the United States the immigrants experience more rapid upward occupational mobility. This U-shaped pattern is least intense for immigrants from English-speaking developed countries (high international transferability of skills) and is most intense for refugees (weak international transferability of skills).

Another dimension of the economic performance of immigrants is their investment in education. In part because of the depreciation of country-specific skills after migrating, immigrants have an incentive to make greater investments in the destination. The extent of these investments is apparently inversely related to the transferability of skills. Refugees undertake greater postmigration schooling investments than economic migrants of a similar origin (Borjas 1982).

3. Other Time Periods and Other Countries

The preceding paragraphs have focused on the contemporary United States because most of the systematic research on the economic performance and education of immigrants has been done for this country. A study of turn-of-the-century immigrants in the United States using modern statistical analysis also found an earnings catch-up at about 11 to 13 years of residence, after which the immigrants had higher earnings (Blau 1979). Studies of immigrants in Canada have found patterns remarkably similar to those for the United States, and Australia, while studies for the United Kingdom reveal that most of the immigrants have highly transferable skills. Immigrants in Israel, however, demonstrate characteristics of noneconomic migrants (refugees and ideological migrants). Among immigrants in Israel there is a very small effect on earnings of preimmigration schooling and labor market experience, and the earnings of immigrants approach but do not catch up with or exceed those of the native born (Chiswick 1979).

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increased duration of residence in the destination their occupational status, earnings, and employment increase. This arises from the adjustment of preimmigration skills and from additional postimmigration investments in human capital, in particular, schooling, on-the-job training, and labor market information.

1. Characteristics of Immigrants

The economic adjustment of immigrants is most easily understood through two models (Chiswick 1978a, 1979). One is the favorable self-selection of immigrants and the other is the international transferability of skills.

1.1 Self-selection

There is a tendency for migrants to higher income areas to be favorably self-selected in comparison with those who remain in the place of origin. In the historical literature, migrants have been variously described as more able, ambitious, entrepreneurial, crafty, aggressive, and avaricious.

A favorable self-selection of immigrants is not difficult to explain. If the ratio of earnings of those of high ability to those of lesser ability are approximately the same across countries, the more able receive a larger absolute increase in income from migration. The value of a unit of time devoted to the migration and readjustment in the destination is roughly proportionate to income, and hence ability. There are, however, many aspects of the move which involve costs that do not vary with ability or for which the more able have lower costs. The costs of purchased inputs, for example an airline ticket, generally do not vary with ability; in addition, the more able may be able, with fewer resources, to achieve the same objectives as the less able. As a result of the higher ratio of benefits to costs from migration for the more able, they have a greater incentive to migrate.

Immigrants are likely to be particularly well-endowed with "allocative skills" (decision-making capability) in contrast with "worker skills" (task performance). Allocative skills are particularly valuable in a new environment in which many decisions need to be made regarding the labor market, training, and consumption behavior.

The intensity of the favorable self-selection of immigrants varies by reason for migrating. It is expected to be strongest for persons whose primary motive is economic betterment. It is expected to be less intense for those for whom factors other than expected relative labor market success are important influences on the migration decision, such as refugees and tied movers. Refugees are those whose migration decision is largely influenced by concerns for personal freedom or safety because of political, ideological, racial, ethnic, religious, or social class reasons. Tied movers are those whose migration decision is largely influenced by the desire to join or accompany a migrating family member.

1.2 International Transferability of Skills

Immigrants have skills acquired in the country of origin. Those migrating to a country in which the language, level of development, and structure of labor markets are similar to the country of origin have greater international transferability of skills. For example, immigrants to Canada from the United Kingdom can be expected to have more highly transferable skills than immigrants from Thailand. The extent of the transferability of skills for a cohort of immigrants will also vary by reason for migrating. More highly transferable skills facilitate the economic adjustment. Since economic migrants have earnings as the primary motive for migrating, they have generally planned for the move and made internationally transferable investments in skill. Refugees generally do not anticipate the move and tend to have made more human capital investments specific to their country of origin. Most refugees would not have left the country of origin if not for the noneconomic factors. For example, physicians have internationally transferable skills and are to be found among economic migrants and refugees, while lawyers and judges have country-specific skills ~~and~~ are found in refugee populations, but seldom among economic migrants.

If skills were perfectly transferable internationally there would be no difference in the effects on earnings of years of schooling and labor market experience between immigrants and natives in the destination, and among the immigrants earnings would not depend on where the schooling and labor market experience were acquired. The weaker the international transferability of skills, however, the smaller is the effect of preimmigration schooling and experience on labor market earnings, the lower the earnings on entering the labor market in the destination, and the greater the favorable effect on earnings of labor market experience acquired in the destination.

2. Immigrants in the United States

These models may be applied to immigrants in any country. The discussion focuses on the United States because most of the research has used United States data. Immigrants to the United States may be classified by the transferability of their skills, such as coming from either English-speaking developed countries (e.g., the United Kingdom, Ireland, Canada, Australia) or other countries, and on the reason for migrating, such as being economic migrants or refugees (and tied movers).

2.1 Earnings

Among economic migrants from English-speaking developed countries the effects on earnings in the United States of schooling and labor market experience are similar to those for the native born. In addition, there is no differential effect on United States earnings of labor market experience in the country of origin and experience in the United States. Among economic migrants from other countries, however, schooling has

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The Economics of the Brain Drain

H. G. Grubel

This article presents the economics of the brain drain by first giving a definition of the concept and explaining why it is of such great political and emotional importance. Next, the motives of brain drain migrants are analyzed and problems of measurement are discussed. The final parts consist of a study of the welfare effects of the brain drain and some policy proposals for dealing with it. The material presented here draws heavily on scholarly books dealing with the economics of the brain drain by Adams (1968) and Grubel and Scott (1977) and on scholarly books with an emphasis on the economics of human capital and migration more generally by Myers (1972) and Psacharopoulos (1973). Blume (1968) and Dedijer and Svenningson (1967) are bibliographies of early writings on the brain drain.

1. *Definition and Historical Background*

Popularly the concept of the brain drain is used to refer to the migration of highly skilled individuals who are trained in one country and take up residence and work in another. Such migration has taken place throughout history, but it became the focus of public attention during the early 1960s when the United States embarked on a major increase of expenditures on science and engineering in order to meet the Soviet challenge symbolized by the launching of Sputnik. These expenditures created an excess demand for highly skilled manpower that was met by immigration. United States immigration laws strictly limit the inflow of foreigners generally but were most liberal in granting visas to highly skilled persons.

At the same time, developing countries launched major efforts to industrialize and other industrial nations attempted to catch up with United States technological and scientific standards. The loss of highly skilled manpower frustrated these countries' economic development efforts and the brain drain became a widely discussed political issue. During the late 1960s and 1970s the brain drain from developing countries to Western Europe and multinational organizations also became sizable and the phenomenon was recognized as a more general problem.

For economic science the brain drain is a component of two separate traditional fields of study: migration and human capital. In the terminology of these fields it involves the crossing of international borders by human capital embodied in and owned by migrants and not recorded in conventional international balance of payments statistics. By this definition, the crossing of borders by highly skilled people on contract to provide human capital services on a project in a country other than their home country does not involve a brain drain. Payment for these services enters balance of payments statistics. On the other hand, when individuals study abroad and return to their home countries, unrecorded human capital crosses borders and involves a form of brain drain.

The preceding considerations suggest that the economics of the brain drain might be called less emotively the economics of international human capital flows. However, the use of the term brain drain is so well-established that it is advantageous to continue its use here in the study of the broader phenomenon of unrecorded migration of human capital.

2. *Motives for Migration of Highly Skilled Workers*

Motives for migration generally and of students and highly skilled workers are complex. However, four main considerations dominate the decision to migrate: income, professional (or study) opportunities, living standards, and working conditions. The migrant considers each of these four elements by comparing conditions between pairs of countries. Personal tastes and circumstances as well as costs of transaction and travel enter individuals' decision-making calculus. The basic calculus is known to many people from personal experience or can be readily envisaged. In practice it is made very difficult by uncertainties surrounding all decision variables and the need to discount future prospects. It is facilitated by the fact that migration can usually be reversed if uncertain events turn out unfavorably. Formal models of the decision-making calculus are found in the literature noted below.

2.1 Survey Studies

One set of empirical studies of motives of brain drain migrants tend to be based on questionnaires designed and administered by sociologists. For a massive study using this approach see Glaser (1973). These studies have tended to find that respondents put professional opportunities as their primary motive, while earnings and living conditions are relatively unimportant. Scepticism has been expressed about the meaning of these findings since respondents may well have been rationalizing their motives and have been conditioned to do so by social pressures in their home countries. It simply is not socially acceptable to leave one's home country and the source of finance for one's education in order to enjoy a higher living standard abroad. Going abroad for better research opportunities, on the other hand, is a more socially acceptable motive.

2.2 Economists' Studies

Economists who have studied migratory patterns have found that wage rate and income differences between countries of migration can explain statistically derived differences in propensities to migrate. The results reconfirm the validity of the basic economic models applicable to all migration, which postulate that people move to maximize the present value of their expected earnings net of costs of moving and adjustment.

These economists' findings about the motives for the brain drain point to difficulties of solving it in the short run except through costly direct controls on international travel or the creation of inefficient and inequitable income gaps between trained and untrained people in losing countries. In the longer run, however, income gaps may be expected to narrow and reduce motives for the brain drain.

3. Magnitude of Brain Drain Flows

Initially during the 1960s evidence on the magnitude of the brain drain was primarily episodal. Newspapers provided a treasure of allegedly representative stories. Efforts by scholars to quantify the phenomenon were stymied by the lack of readily accessible and suitable data. The most readily available data for any kind of quantification were those of the United States immigration and naturalization service. They showed that indeed there were large numbers of highly skilled migrants who acquired United States immigration visas. In some fields such as nursing and medicine the numbers represented sizable proportions of total United States production of such skills. For skills other than medical, however, the flows by and large represented relatively small proportions of both stocks and flows of newly trained personnel in the United States and most of the countries of emigration.

Using the United States statistics on flows and multiplying the number of migrants by the estimated present value of their earnings due to higher education, that is their human capital value, resulted in figures that were large relative to United States foreign aid, especially that to India. This fact was used by some politicians to dramatize the problem of the brain drain and to demand United States or collective world action to remedy the resultant injustices. As will be seen below, it is highly misleading to compare flows of foreign aid and migrating human capital in order to make inferences about welfare effects and moral debt relationships.

3.1 Problems with United States Immigration Statistics

Later research, as summarized by Friborg (1975) and discussed in the Committee on Foreign Affairs (1974), revealed that the United States immigration statistics and their early uses failed to reflect three important aspects of the brain drain. First, a substantial proportion of the United States immigrants were individuals who had obtained part or all of their higher education in the United States and were financed by United States funds or their own work. In fact, these individuals left their home countries as unskilled laborers and therefore, if anything, reflected a policy of United States immigration that was welcome by most people. To obtain information on the educational background of brain drain migrants, it was necessary to analyze biographic information on the stock of United States scientific and technical personnel. Such analysis showed that a foreign Ph.D. was held by only one-third of foreign-born United States scientists. In all likelihood, brain drain flows during the postwar years had similar characteristics.

Second, the United States statistics failed to record return flows of highly skilled people to their native or third countries. Since no major countries keep records of returning natives classed by education levels and there are no data collected on people leaving the United States, again information on net flows could be obtained only from statistics on stocks. The use of military and church records in some European countries permitted inferences to be made about net versus gross migration. For the countries and professions surveyed during the 1960s, emigration to the United States tended to be matched by return migration to such an extent that the net averaged only about 30 percent of the gross. Analogous data for developing countries are not available.

Third, the United States immigration data contained no information on the number and human capital value of migrants returning to their home or native countries after study in the United States. Since the brain drain is just one aspect of the international circulation of human capital and is in an important sense a part of the cost of foreign student training, the value of student capital should be compared with the value of the genuine

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brain drain capital. A special survey of Canadian economists in Canada and in United States positions revealed that even though Canada suffered a deficit on conventional brain drain account, her overall human capital account was positive by a large margin because many Canadians obtain graduate degrees in the United States.

The continuous and accurate measurement of presently unrecorded international human capital flows remains an elusive goal whose attainment is considered desirable because it would permit more rational discussion of and policies for control of the brain drain. However, since existing data do not permit the construction of such statistics and the cost of new data collection procedures is very high in relation to the expected benefits from their use, quantitative information on the magnitude of international human capital flows is likely to continue to come in the future from isolated efforts providing bench mark information and using data collected for other purposes.

4. *Welfare Effects: Short-run Output Effects*

When a country unexpectedly loses through emigration a highly skilled person there are likely to be short-run adjustment costs since technologically optimal efficiency is achieved by the cooperation of human capital with physical capital and labor in a mix determined by the state of knowledge and relative prices of the three types of inputs. Thus when a supervising engineer suddenly leaves a plant, in the extreme case where he is totally indispensable, machines and labor have to remain idle until a replacement is found. Typically engineers are not totally indispensable and output efficiency of capital and labor drops only somewhat, depending on the nature of the technology. The temporary losses can be reduced for any given technology if the departure of the engineer is known in advance. In the extreme, there need be no adjustment costs at all.

The argument just presented in the context of an individual firm or plant also applies in its basic outline to society as a whole, except that replacements of skilled persons cannot simply be hired from another job but require time-consuming education and therefore may involve longer periods of inefficient operating procedures. However, if emigration can be predicted, then it is possible to plan education in such a way that there are never any short-run shortages of skilled people and the economy operates at all times with the technologically optimal mix of human and real capital and labor.

In the real world, short-run adjustment costs are likely to be minor and human capital losses have been quite predictable. Some analysts argue that in some countries, such as India, political processes or planning errors have resulted in an excess production of human capital for given knowledge and physical capital and labor. In the case of such countries short-run losses are nil since emigrating human capital was unemployed.

5. *Long-run Output Effects*

Long-run output effects of the emigration of human capital can usefully be analyzed with the help of what is known as the generalized theory of capital. According to this model, society can invest its stock of capital in knowledge, and human and physical capital. Markets, competition, and patent laws result in a tendency for the marginal productivity of each capital form to be equal and society's output to be maximized. The three forms of capital can be added up to find the overall endowment of labor with capital.

Now consider that a country in efficient equilibrium with respect to the distribution of the stock of the three types of capital loses a certain amount of human capital and labor through emigration. A reallocation of society's remaining capital stock is likely to be necessary and may be assumed to take place. In the new equilibrium that country's total output will be lower than before the loss of the labor and capital. However, under relatively simple and usual assumptions about the nature of the production function, total output per worker in the country may be raised or lowered or remain unchanged. It will be lowered if the amount of human capital taken along by the average emigrant is greater than the original overall capital per worker simply because under these conditions the postemigration stock of capital per worker in the country is lowered. Since productivity and output are an increasing function of the overall capital–labor ratio, the smaller ratio brought about by the emigration leads to lower labor productivity and average income.

It is easy to see that average output remains unchanged if the emigrants' capital per person equals the country's initial overall stock of capital per worker and that it will be raised if emigrants take along less than the average. The emigration of unskilled workers according to this model must always raise output per capita of the remaining workers. This fact may well explain why there is so rarely opposition to the emigration of unskilled workers.

In a very rough calculation it was found that in the mid-1960s the human capital value of two years' university training in India was about equal to the average of human and physical capital per Indian worker. This result suggests that the loss of university graduates somewhat lowers, and of beginning university students somewhat raises, India's capital stock per worker and income per person.

The preceding model of the real output effects of the brain drain over-simplifies a complex process in many ways but provides a useful focus and directs attention to the essential aspects of the migration of highly skilled persons.

6 *Welfare Effects*

6.1 *The Nationalist Model*

The brain drain became the source of much public concern in the 1960s and continues to occupy discussions at the United Nations Commission for Trade and Development (UNCTAD) and other UN agencies because of the following perception of the welfare effects and inequities. The population of a country taxes itself to finance the operation of institutions of higher learning or the study of citizens abroad. This collective investment in education is made in expectation of general returns to society: the country's total output is raised, the productivity of cooperating factors of production is increased, a greater tax base permits raising more revenue to be spent on further development and on welfare projects, and the country as a whole moves into the modern age improved by science and technology and accompanying externalities. Moreover, competitive selection processes of education tend to provide education to the most gifted and dynamic young people who are sources of leadership generally and carriers of desirable genetic material.

Given these expectations of return from investment in the education of young people, their emigration or failure to return from study abroad represents a serious loss. Basically, the investment has been wasted and what makes this waste particularly hard to take is that it involves great inequities. For example, in developing countries people with low and average incomes have lowered their incomes to finance education, the benefits of which now accrue to the emigrants who live in the lap of luxury in industrial countries and add to the further growth and tax base of peoples who have incomes that are a multiple of those who financed the migrants' education. Projects for the provision of very basic technology and medical services in developing countries suffer or have to be abandoned because of the lack of skilled manpower while those brain drain migrants make possible technical and medical projects in industrial countries that represent basically unnecessary luxuries.

Under this nationalistic view, the effects of the brain drain are often quantified by measuring the value of income earned by brain drain migrants in their countries of new residence. This sum is then considered to represent the inequitable transfer of resources from poor to rich nations.

6.2 The Internationalist View

Economists have approached the analysis of the welfare effects of the brain drain by building logically rigorous models based on simple and widely accepted principles of economics. The resultant model and conclusions have become known as the internationalist approach for reasons that will become obvious. The basics of this model are as follows.

Consider a world of nation-states in which all people are paid an income equal to the value of their contribution to the nation's output. This assumption reflects one of the cornerstones of modern price theory and is known as the marginal productivity theory of factor incomes. It implies that there are no externalities from work so that a skilled person provides no benefits to society other than those for which payment is received. This assumption is unrealistic and will be relaxed below. As a second basic initial assumption consider that in this hypothetical world all education is financed privately by parents.

In a world without externalities and government-financed education the emigration of one or a small number of highly skilled persons leaves unchanged the welfare of those left behind because the migrants take along an equal valued contribution and claim to output. Thus, the emigration of Indian scientists who earned x rupees in their home country lowers that country's national output by x rupees but does not affect the income of those remaining behind.

In the country of immigration, the brain drain migrants contribute to output exactly what they are paid and use as claim on the output. Therefore they do not alter the incomes of the people there. The migrants, however, raise their own incomes. Under the assumption that welfare is an increasing function of income, we reach the important fundamental conclusion that the migration raises world welfare since that of the migrants is raised and that of the population in the receiving and sending countries is unchanged.

6.3 Role of Education Financing

Under a system where education is financed by parents, basically any debt obligations are between members of a family and should not be of concern to the state. However, it is useful to consider two polar views of the nature of the intergenerational obligation arising through the financing of childrens' education within families because most people can relate to this situation and it provides good insights into the nature of obligations arising out of publicly financed education systems.

Under one basic view children and their education are considered to be an investment good which yields returns when the children look after the welfare of their parents in old age. When children emigrate they may renege on their obligations to parents but they may also end up making better provision for them out of higher incomes than they would have if they had not emigrated.

Under the second basic view children are a consumption good and parents have a moral obligation to raise and educate their offspring just like their parents and every generation of parents have done. The obligation of every productive generation is not to their parents but to their own children. Under this view educated emigrants leave no obligations behind because they take along their offspring.

These two views of the nature of the obligation can readily be translated into the more realistic situation where education is financed by public education. Under the investment view, emigrants owe repayment through taxes to finance pensions and welfare expenditures. Emigration therefore involves a clear-cut reneging on a moral obligation and lowering of welfare of those left behind. Under the consumption view of children, on the other hand, those left behind do not suffer a reduction in welfare since the emigrants take along both their contributions to taxes used for financing education and their children on whom this tax money would have to be spent.

It is probably true that the investment view of children and education dominates attitudes in developing countries while the consumption view dominates attitudes in industrial countries. If this judgment is correct it can help to explain why concern over the inequities of the brain drain is so much more prevalent in developing than industrialized countries.

6.4 *General Government Taxes and Services*

The preceding argument over the financing of education can be generalized to tax payments and all government services generally. Emigrants reduce tax revenue and demand for all government services simultaneously, leaving unchanged tax burdens on those remaining behind. By analogy, there are no gains to taxpayers in countries of immigration. There may be some secondary effects on welfare if the taxes paid exceed the value of benefits received and if government services provided are lumpy such that expenditures remain unchanged regardless of how many people are served. Typically, however, educated high-income taxpayers also demand high levels and quality of services, as for example legal, police, pension, and education programs. Lumpiness of expenditures on such items as defense and roads tends to be invariable only in the short run.

6.5 *Externalities from Work of Migrants*

Highly educated people are believed to provide societies with many positive externalities through leadership and contributions to arts, sciences, and culture generally. To the extent that this is true, the emigration of highly trained individuals lowers the welfare of those left behind. Undoubtedly, the loss of such externalities represents a valid and important flow of welfare from losing to gaining countries.

However, it is easy to overestimate the importance of these externalities. Most artistic, scientific, and technical contributions are rewarded through salaries or the sale of copyrighted publications and patents, typically leaving uncompensated only contributions to strictly nationalistic feelings of pride. The production of pure knowledge that cannot be patented is usually an international good, the benefits of which accrue to the world as a whole including the home country of the brain drain emigrant. The real benefits of a scientific breakthrough leading to a cancer cure, for example, accrue to Indians whether an Indian scientist does the research in the United States or his native country.

It is also misleading to consider the scientific and other achievements of brain drain migrants in their new countries of residence and infer that the real benefits or glory of their achievement would have accrued to their home countries if they had not emigrated. In many instances, these achievements would not have been possible in the home countries because of the lack of scientific support facilities and colleagues.

Highly skilled persons could also be considered to sometimes provide negative externalities, not just positive leadership qualities. Historically, academics generally and the academic proletariat of underemployed intellectuals have at times provided the stimulus for civil unrest and revolutions that turned out not to have been in the longer run interest of countries. The emigration of such highly skilled potential revolutionaries can have positive externalities for their home countries.

6.6 *Nonmarginal Flows*

The preceding analysis of welfare effects assumed implicitly that migration involved small numbers and therefore could be treated as marginal. In fact, brain drain flows have been and are marginal by almost all standards. However, economic models of nonmarginal changes have also been constructed. They produce the following need for modification of the above conclusions.

If large numbers of unskilled workers leave a country, the capital–labor ratio and therefore the marginal productivity of the remaining labor are raised while the return to capital falls. In the receiving country the opposite effect takes place. Thus, large-scale general labor migration has income redistribution effects that are considered to be desirable by many people. However, if such large-scale migration involves highly trained individuals, the accompanying changes in the overall capital–labor ratio reduce and may reverse this income redistribution effect. In the country of emigration wage rates rise less or may even fall and in the country of immigration they fall less or may even rise.

6.7 *Benefits from Mobility*

In the technical and quantitative discussion of the economic effects of the brain drain sight is often lost of the fact that it is part of the general phenomenon of the international circulation of human beings that includes travel for business, recreation, and study, all of which involve stays abroad of varying length. As was noted above, some of the seemingly permanent brain drain migration involves stays of limited duration and there is some practical ambiguity between study, advanced training, and permanent migration.

The international circulation of people generally provides enormous benefits to humanity. The educational experiences of travel are recognized widely. Most of today's leaders in all fields of human endeavor have studied or worked abroad temporarily during their careers. Contacts among people from different nationalities raise tolerance and understanding and thus lower the risks of international conflict. There is no doubt that without the international circulation of people the world would be a much less attractive place. The brain drain, which involves some people extending or making permanent their stay abroad, may usefully be considered as part of the cost, much like the cost of transportation, that has to be incurred in order to derive these benefits.

7. Policy Recommendations

Given the public concern over the brain drain and the political rhetoric about it in international organizations, there have been surprisingly few solid policy proposals on either how to reduce it or how to deal with its consequences. There are three types of policy recommendations.

First, there are those policies that would reduce the incentives without interfering with the flow of students and professionals in any way. The basic objective of these policies is to raise the incomes and working conditions of highly skilled people in countries that suffer from the brain drain. These policy recommendations are unrealistic in that given the scarcity of resources and many different development objectives of most countries, raising highly skilled peoples' incomes and expanding research facilities is not one of the most important priorities. Moreover, it would lead to inequities and inefficiencies. The creation of international research institutes where scientists from developing countries can go for temporary work and updating of skills has been proposed but failed to find sponsors.

Second, there have been proposals to change immigration policies of brain drain gaining countries to make them less discriminatory in favor of highly skilled people and to make it more difficult for students and temporary visitors to obtain permanent resident status. United States and Canadian policies in this regard have been tightened during the 1960s as part of a general move towards admissions procedures that discriminate on the basis of time of application rather than national origin, wealth, and other allegedly discriminatory criteria. However, the governments of industrial countries have resisted all pressures from more radical elements in developing countries to initiate easy procedures whereby foreign students and other highly skilled persons can be extradicted on request of native countries' governments. There has been concern about the abuse of such procedures for political purposes. Developing countries have attempted generally to use legal techniques to assure return of students sponsored by official sources, but they have no effective leverage to assure the return of students sponsored privately. Except for countries of the socialist bloc, none have introduced prohibitions on travel to prevent the brain drain.

The third set of proposals is aimed at redressing the inequities which are alleged to arise under the nationalistic view from the debt on educational outlays owed to the losing countries. One set of proposals suggests bilateral intergovernmental compensation agreements. Such an approach might encourage the development of international specialization in the production and export of human skills.

Another widely discussed set of proposals requires that brain drain migrants be assessed for a special tax surcharge which is transmitted to the countries in which they were educated, either directly or through some international organization. Neither of these proposals has been adopted, though the tax scheme has been discussed widely among academics mainly through the initiative of J. Bhagwati (1976).

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Earnings and Education

M. Woodhall

It is a well-established fact that educated workers earn higher wages or salaries than those who are illiterate or those who have completed less education, or have lower educational qualifications. In both developed and less developed economies, in capitalist and socialist countries alike, there is a relationship between education and earnings. This relationship has been extensively analysed in order to throw light on the relationship between education and economic growth, to measure the social and private returns to education, to evaluate education as a form of investment in human capital, and to examine the links between education and the distribution of income.

The relationship between education and earnings is important on distributional grounds because the distribution of educational opportunities will have an impact on the future distribution of income, so that governments committed to long-term redistribution of income must consider the role of education. However this is still a matter of considerable controversy, with some economists arguing that there are strong links between education and earning capacity, while others point to the importance of inherited characteristics, family background, and pure luck in determining an individual's earning power.

The links between education and earnings are also of crucial importance in decisions about the efficient allocation of resources, since it is argued that the higher earnings of the educated reflect their superior productivity. However, the pattern of wages and salaries reflects many other factors, apart from the education of workers. Not only the individual's natural ability, family background, and other personal characteristics, but also historical and institutional factors and trade union bargaining all help to determine the pattern of earnings differentials. Thus, there is considerable disagreement between economists who argue that education is a form of investment in human capital, and that techniques such as cost–benefit analysis should be used as a guide to resource allocation, and those who argue that education simply acts as a screening device, allowing employers to identify the most productive workers. An alternative objection to the notion of human capital is put forward by those who point to the existence of dual or segmented labour markets, with educated workers tending to concentrate in the primary sectors, and other workers, including the less educated, but also including women and workers who are likely to be discriminated against on grounds of race or background, confined to secondary labour markets, where different factors determine earnings.

For a variety of reasons, therefore, the relationship between education and earnings is important but controversial, and disagreement centres around the question of what determines an individual's earning capacity, whether the existence of earnings differentials reflects differences in the productivity of workers, and how information about earnings differentials should be used to guide educational planning decisions. The one point of general agreement is that education and earnings are closely related. Blaug sums up the evidence as follows:

> We begin by noting a remarkable fact of life: between any two groups of individuals of the same age and sex, the one with more education will have higher average earnings than the one with less, even if the two groups are employed in the same occupational category in the same industry. The universality of this positive association between education and earnings is one of the most striking findings of modern social science. It is indeed one of the few safe generalizations that one can make about labour markets in all countries, whether capitalist or communist. (Blaug 1972 p. 54)

Data on average earnings and level of educational attainment of samples of workers exist now for at least 40 countries, and there is no doubt that it is the workers with higher levels of education who enjoy high earnings. Data on earnings can be collected on a time-series basis, which shows how the pattern of wages and salaries changes over time, or on a cross-section basis, which shows how earnings vary with the age, educational level, and other personal characteristics of workers, at a single point in time.

The relationship between the costs of acquiring education and the extra lifetime income that can be expected as a result of investing in education forms the basis of cost–benefit analysis of education, which usually relies on cross-section data on earnings. The question of how much education contributes to economic growth through improvements in the quality of the labour force requires time-series data. A third type of analysis, the study of earnings functions, attempts to explain what determines earnings and variations in earning power, and compares the relative importance of education and other factors, such as race, sex, family background, ability, and occupation, in determining wages and salaries. All three types of analysis use data on the average annual earnings of workers with different levels of education to construct age–earnings profiles, which show the expected lifetime earnings associated with different amounts or types of education. These age–earnings profiles show that the average earnings of samples of workers are closely correlated with both the age and educational attainment of the workers, even though for the individual the relationship may be less close.

1. Age–Earnings Profiles

Information on earnings and level of education has been collected regularly in the United States census since the 1940s, but most countries have to rely on sample surveys for data on the average earnings of workers, classified

PART V

The Analysis of Earnings

Income Distribution and Education

B. R. Chiswick; C. U. Chiswick

Education affects, and is affected by, the productivity of individuals and hence the distribution of income. There are two dimensions to the distribution of income, the functional distribution and the personal distribution. The functional distribution of income is concerned with the distribution of the output of an economy among the factors of production. For example, what is the share of national income or gross national product (GNP) received by labor and by capital? The personal distribution of income, on the other hand, is concerned with the sources and magnitudes of income received by individuals, families, or households. For example, what is the distribution of labor market earnings among adult men, or income from all sources for households?

When the economy is simple and household survey data on income are scarce, analyses of the functional distribution of income are used to generate insights regarding the personal distribution of income. As long as most people are of equal skill and provide only labor services, and a small group owns nearly all of the land (or physical capital), there is a close link between the functional and personal distributions. For example, an increase in the rental value of land increases the share of national income received by landowners and thus increases the inequality in the personal distribution of income. In more advanced and complex economies, however, the link is attenuated. In such economies workers cannot be viewed as though they were all equally skilled, nor may it be assumed that nonlabor income accrues primarily to a class of nonworking individuals. Indeed, workers may own a substantial part of the capital stock either directly through investing their own savings or indirectly through their life insurance policies and pension programs. With the more complex structure in advanced economies and the development of household survey data on the personal distribution of income, the analyses of the two dimensions of the distribution of income have taken separate paths.

For various different reasons, the analyses of the functional and personal distributions of income were of only limited applicability until the development of human capital theory in the 1960s. The incorporation of human capital theory into the functional distribution analysis showed the importance of viewing labor as the skills embodied in workers rather than the workers themselves. The major insights were (a) that in the modern world labor should be viewed as two or three separate factors of production, and (b) that the qualities of these labor resources are at least as important as the number of workers for the determination of incomes and factor shares. This reinterpretation of the human factor has also permitted the reconciliation of several outstanding issues regarding the elasticity of substitution among factors of production, thus facilitating analysis of the effects of economic growth on the functional distribution of income.

Analyses of the personal distribution of income had been based primarily on ad hoc models of ability and luck. With the advent of human capital theory behavioral models of income distribution were developed that provided robust systematic analyses of the shape and dispersion of the personal distribution of income over space (geographic areas) and time and across demographic groups. Unlike the earlier analyses, the models based on human capital theory generated testable hypotheses.

1. The Functional Distribution of Income

1.1 Definition of Factors

The functional distribution of income refers to the way in which owners of resources (i.e., land, labor, and capital) divide the income earned from their combined production efforts. The classical economists considered land and labor to be the essential factors of production, the basic resources from which all goods and services were produced. With industrialization the list was soon expanded to include capital, which soon replaced land as the most important nonhuman factor of production. More recently, modern technology has led to the growing importance of professional and high-level technical skills. These skills enter the production process in a fundamentally different way than conventional labor and so are increasingly regarded as a distinct factor of production.

Traditionally, capital is the factor of production that results from the accumulation of investment whereas labor is the factor that depends primarily on the size of the labor force. Some economists have argued from this that the capital factor should include human as well as physical capital, limiting the labor factor to unskilled "raw" labor. However, the returns to investment in human capital are incorporated into the wage structure and constitute labor income. It is thus more natural to think of the labor factor as skills rather than workers. Those workers (if any) with no skills may simply be treated as a separate factor of production.

Recent theory makes a distinction between production skills and allocative skills (Schultz 1975). Allocative skill refers to the ability to make decisions as to the most efficient ways of converting resources into outputs. The classical economists assumed that such decisions would be made by the owners of the means of production, by which they meant the owners of land or capital. This is no longer appropriate. It has often been noted that a firm's decisions are typically made by a special cadre of salaried employees (Parsons 1968). In fact, high-level manpower has emerged as an important component of the labor force whose use in production is so different from that of conventional labor that it is often referred to as "nonproduction" labor. Since it is nevertheless a critical resource which modern production requires it cannot be omitted from the resource endowment of an economy. The recommended procedure, therefore, is to separate human capital into two distinct factors of production corresponding to high-level and conventional manpower.

Although each of the basic factors of production is broad enough to include a wide variety of "shapes," each with its own distinctive characteristics, there must be sufficient homogeneity to justify considering it as a single resource. Thus, it must be possible to discuss a market for each labor factor, as for land and capital, which is sufficiently coherent that it can be expressed in terms of the supply of and demand for fairly homogeneous labor units at a particular price. This requires that the flow of services from each factor of production be expressed in terms of some quantity unit for which a unit price exists.

Physical capital and the two kinds of human capital are best treated as analogous factors of production, each of which can be measured in appropriate efficiency units and accumulated through investment. This is already common practice in the case of physical capital, since it has long been recognized that the number of "machines" in which physical capital is embodied has no bearing on the "amount" of that factor which can be used for production. This approach is not as widespread in the case of human capital, where the number of hours worked is often viewed as a measure of the quantity of labor. It is now generally agreed, however, that hours worked is an inadequate indicator of the factor endowment since the quality of labor (e.g., skills) varies considerably among workers. The efficiency-unit approach assumes that production depends on the services provided by workers rather than the time spent working. Thus it is not relevant to the determination of production levels whether the "amount" of human capital available is embodied in a specified number of people or whether it is emobodied in half as many people who work twice as efficiently.

1.2 Generation of Factor Incomes

Consider the role of education as a form of investment in human capital. Let H_0 denote the human factor of production which requires little or no formal education for its accumulation, corresponding roughly to that kind of labor usually attributed to the traditional sector in less developed countries (LDCs). Let H_1 denote the human capital generally associated with modern production, skills which may be accumulated by some sort of technical training both within the formal school system and through informal and nonformal training programs in the workplace (on-the-job training). Finally, let H_2 denote the human capital generally referred to as high-level manpower, skills associated with professional and technical occupations and typically requiring advanced schooling as well as a period of on-the-job training. Each of these three types of human capital may be considered a distinct factor of production in that their prices are determined in fairly different markets for labor services.

Education has two distinct effects on the amounts of human capital of each of these types and hence on factor proportions. For each type of skill, education may be a means of improvement or enhancement for a given worker, increasing the number of efficiency units embodied in that worker and hence the total number of efficiency units available to the economy. Apart from this, education is the main avenue for mobility between factors of production. For example, a worker whose skills are those associated with H_0 may choose to undertake some form of education to enhance those skills, and thus raise his or her efficiency, without actually changing the nature of the work performed. Or, they may choose to undertake an educational program that will provide the skills generally associated with modern production work, effectively increasing H_1 for the economy as a whole at the expense of a reduction in H_0.

Mobility of labor from one human factor of production to another is limited by the length, difficulty, and accessibility of the educational process required for a worker with one set of skills to acquire another set. As the factors have been defined here, the pairwise cross-elasticities of labor supply between the three groups must be fairly low in the short run. If one of the factors is particularly scarce—as high-level manpower might be, for example, in one of the less developed countries—expanding opportunities for higher education might yield a high proportionate increase in H_2, most likely at the expense of modern production skills H_1, and hence a dramatic change in factor proportions even in so short a period as 10 years. In the more typical situation for a moderately industrialized country, however, an expansion of higher education would have to persist through a number of cohorts of students before the effect on factor proportions would be appreciable.

The relationship between aggregate resources and the potential production of goods and services for the economy as a whole is formally described in terms of an aggregate production function:

$$Y = f(X) \tag{1}$$

where Y is the total value added for the time period under consideration and X is a vector of factors of production, each measured in its respective efficiency units. This function gives the maximum value of output that is attainable for a given resource base if resources are efficiently allocated, a condition which requires that the ratio of marginal products for any two factors be equal to their relative scarcity values. From this condition, marginal products are often referred to as shadow prices; in a well-functioning market economy the shadow price of a factor should be close to or the same as its market price.

The most important parameters of the production (e.g., IQ) tests was constructed so as to approximate a normal distribution. But if ability were normally distributed, would not the resulting income distribution be normally distributed? Models of the relation between income and ability were developed to generate the positive skewness of the distribution of income. For example, a small positive skewness emerges if income were the consequence of the product of several statistically independent dimensions of ability, each of which is normally distributed. The positive skewness would be even greater if there were a positive correlation among ability measures. Of course, the assumptions that ability is normally distributed and that income is a function of the product of ability measures are arbitrary.

Luck was also viewed as a potential determinant of the income distribution. A normal distribution of luck would, however, seem to imply a normal distribution of income. If the effects of luck were multiplicative and either independent from one time period to the next or positively correlated (i.e., good luck this year means a better-than-average chance of good luck next year) across time periods, a positively skewed distribution of income would emerge. This implies, however, an ever-increasing inequality in the distribution of income. More complex models were needed for luck to generate both the observed skewness and the apparent stability in income distribution over time.

These analyses of ability and luck were generating ever more complex but ultimately sterile mathematical models. They suffered from the problems of internal inconsistency mentioned above. Nor did they provide explanations for differences in the distribution of income across geographic areas, time periods, or demographic groups. Moreover, they were devoid of behavioral responses—they were not grounded in any model based on the behavior of individuals.

2.2 The Human Capital Model

Human capital theory provides a behavioral basis for an analysis of the personal distribution of income. Individuals invest in education in order to raise their earning power. They decide to undertake schooling, postschool training and other methods of human capital formation by considering the marginal rate of return on these investments (demand for funds schedule) and the marginal interest cost of the funds used to finance them (supply of funds schedule). The demand schedule is downward sloping under the assumption that beyond some point, additional investments yield smaller and smaller returns. The supply schedule is upward rising under the assumption that cheaper sources of funds are used before more expensive sources.

The marginal rate of return (demand) schedule, which relates the rate of return on an extra unit of funds invested in human capital to the level of the investment, may differ among individuals. This schedule is higher for those with greater ability to convert human capital into earnings, ability which may be inherited (genetic), the result of a more favorable home environment, or a consequence of complementary investments. The marginal interest cost of funds schedule may also vary among individuals. The interest cost of funds schedule is lower for those with easier access to financing because of greater parental wealth or greater access to public subsidies. A schematic representation of these schedules is shown in Fig. 1 (Becker and Chiswick 1966, Becker 1975). There are theoretical reasons for believing that in general those with a higher demand curve have a lower supply curve, that is, a supply curve that is further to the right.

Optimization for the individual occurs where the marginal rate of return equals the marginal interest cost of funds. This determines the level of education and marginal rate of return on the investment. An individual's labor market income is the income that would have been received if there had been no investment in human capital plus the area under the marginal rate of return schedule. Hence, the distribution of income is related to the distribution of the demand schedules, the distribution of the supply schedules, and the correlation between these two distributions (Becker and Chiswick 1966, Becker 1975).

The dispersion in the distribution of demand schedules (D_0D_0, D_1D_1, D_2D_2 in Fig. 1) is referred to as the inequality of "ability." The dispersion in the distribution of supply schedules (S_0S_0, S_1S_1, S_2S_2) is referred to as the inequality of "opportunity." In a meritocracy, all persons would have equal access to funds for investment in human capital, so the same supply of funds schedule would be relevant for all individuals. Any dispersion in education and hence income would arise from the dispersion in ability (demand schedules); those with higher levels of ability would make greater investments and have higher incomes. The greater the inequality of ability, the greater the inequality in education and income.

If all persons were of equal ability for converting investments into income, the marginal rate of return

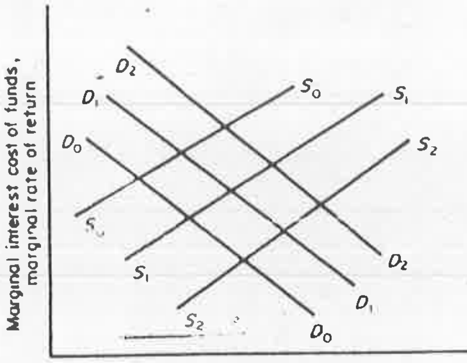

Figure 1
Schematic representation of the supply and demand curves for funds for investment in human capital

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schedule would not vary. Inequality in education and income would arise from the inequality of opportunity, that is, the dispersion in access to funds for investment. Those with a lower interest cost of funds, perhaps because of greater family wealth, would make larger investments and have higher income. The greater the inequality in opportunity, the greater the inequality of education and income.

When both abilities and opportunities vary, the correlation between the two distributions is also relevant. A negative correlation between the supply and demand curves (i.e., a tendency for those with low interest cost of funds to have high demand curves), implies greater inequality in education and hence earnings. In contrast, if the supply and demand curves were sufficiently positively correlated (that is, if advantages in terms of greater ability were offset by disadvantages in access to funds for investment), the inequality in investments and earnings could actually disappear.

There are both theoretical and empirical reasons for believing that the correlation between supply and demand curves is negative. Young people from wealthier families are more likely to have been raised in a home environment that increases ability, either directly or indirectly through complementary investments in health, preschool training, and other training concurrent with schooling. In addition to environmental factors there may also be a genetic link if parents with greater genetic ability acquire greater wealth and can also transmit part of their genetic advantage to their offspring.

Many public policies are designed to alter the dispersions of the supply and demand curves and the correlation between them. Programs to enrich the educational experiences of children from poor or deprived families reduce the dispersion in ability. Minimum-schooling laws are designed to raise the investment levels of those who would otherwise be at the bottom end of the distribution, thereby narrowing the distribution of labor market income. The provision of free public education reduces the dispersion in access to funds for investments in schooling. Loans for higher education for students from low-income families also reduce the inequality in opportunity and hence the correlation between ability and access to funds.

The direct empirical application of these analytical concepts to the analysis of the personal distribution of income is limited by the absence of data on the distribution of funds invested in human capital. Data for several countries are readily available on the earnings (or income) of individuals and on years of schooling and labor market experience, but not on the magnitude of funds actually invested.

2.3 The Relation Between Income and Education

The link between income distribution and education in empirical studies is based on the reduced form equation referred to in the literature as the "human capital earnings function." Analytically, income can be viewed as a function of funds invested in human capital—schoo on-the-job training, labor market information, an on. The human capital earnings function was develo as an empirical technique for dealing with the abse of data on the distribution of investment; it achie this by converting the relationship between income funds invested into a relationship between income time-equivalents of investments in schooling and the-job training (Becker and Chiswick 1966, Min 1974).

In the simplest formulation, let Y_0 be income if the is no investment, C_0 the funds invested in training the initial period, k_0 the ratio of investment to potenti income (C_0/Y_0) in the initial period, r_0 the rate return on this investment, and Y_1 the earnings after th investment. Then,

$$Y_1 = Y_0 + r_0C_0 = Y_0(1 + r_0k_0)$$

(4

If there were investments in a second period of training potential earnings after the training would be

$$\begin{aligned} Y_2 &= Y_1 + r_1C_1 \\ &= Y_1(1 + r_1k_1) \\ &= Y_0(1 + r_0k_0)(1 + r_1k_1) \end{aligned}$$

(5

Using the principle of mathematical induction, it can be shown that potential earnings after N years of training are:

$$Y_N = Y_0 \prod_{i=0}^{N-1} (1 + r_ik_i) \tag{6}$$

For simplicity of exposition, assume that the r_i and k_i are the same for all levels of training. Then,

$$Y_N = Y_0(1 + rk)^N \tag{7}$$

The power N represents the number of years in which investments are made, and k measures the "intensity" of the investment in each year (the fraction of potential earnings that are invested). Taking the natural logarithm of both sides of Eqn. (7) and using the approximation that $\ln(1 + x) \approx x$ if x is a small number,

$$\ln Y_N = \ln Y_0 + (rk)N \tag{8}$$

Under the assumptions used to develop Eqn. (8), the distribution of relative income (i.e., the distribution of the natural logarithm of income) is a function of the distribution of the rate of return on investments in human capital (r), the distribution of the intensities of the investment (k), the distribution of the years of investment (N), and the interrelationships among these distributions.

The empirical studies using this approach typically decompose years of training (N) into schooling (S) and postschool training (T). For schooling it is typically assumed that k is the same in all years. Since the coefficient of schooling is rk, if k can be estimated independently the rate of return from schooling can also be estimated. For postschool training it is typically assumed that k starts below unity and declines linearly to zero. This assumption for postschool training results in a simple specification of the postschool investment component as a quadratic function of T (that is, a linear function of both T and T^2) (Mincer 1974).

The human capital equation has been applied to the analysis of the relative inequality of income across geographic areas and over time. Returning to Eqn. (8), if $\ln Y_0$, r, and k are assumed constant across individuals, taking the variance of both sides of the equation generates:

$$\mathrm{Var}(\ln Y) = (rk)^2\, \mathrm{Var}(N) \qquad (9)$$

That is, the relative inequality of income is a function of the rate of return to the investment, the intensity of investment in a year, and the inequality in years of investment (Becker and Chiswick 1966).

Taking the variance of the expanded human capital earnings function, where years of training is decomposed into its schooling and postschool (on-the-job training) components, gives the relative variance in income as a linear function of the variance in years of schooling, the variance in years of postschool training, and the covariance between the two. In addition, the variance in the natural logarithm of income is a rising function of the rates of return from schooling and postschool training (Chiswick 1974).

2.4 *Education and the Distribution of Income: Cross-section Studies*

In the earliest applications of Eqn. (8), N was assumed to be the number of years of formal schooling, and investments in on-the-job training and other forms of human capital were relegated to a residual. It was also assumed that rk was approximately constant across individuals. The shape of the distribution of the logarithm of income would then be a linear function of the shape of the distribution of years of schooling. A normal distribution of schooling would generate a log normal (positively skewed) distribution of income (Mincer 1958). For a given distribution of schooling, the skewness in income would be greater the higher the rate of return from schooling.

Within schooling levels, the distribution of the natural logarithm of income reflects the distribution of rates of return from schooling. These rates of return reflect differences in "ability." For a given level of schooling, a normal distribution of ability generates a log normal (positively skewed) distribution of income. If schooling levels and rates of return are statistically independent and the distributions of both schooling and rates of return are normal, the logarithm of income would be the product of two independently distributed normal variables which has a small positive skewness.

Empirical studies of the skewness of income across geographic areas have been done for the United States and Canada using the states and provinces, respectively, as units of observation (Chiswick 1970). The distribution of years of schooling approximates a normal distribution, although there is evidence of negative skewness for states with high levels of schooling and positive skewness for states with low levels of schooling. The analysis indicates that much of the positive skewness in the distribution of income can be attributed to the distribution of schooling. The income distribution for adult men is more positively skewed the greater is the skewness in the distribution of schooling and the higher the rate of return from schooling in the state or province.

The extended human capital model of income inequality has been tested empirically using data for states of the United States, the provinces of Canada, and also across countries (Chiswick 1974). Income inequality is found to be greater in geographic areas with higher rates of return from schooling, a greater inequality in schooling, and a greater inequality in labor market experience. For example, 60 percent of state differences in the income inequality among adult men in the United States in 1970 can be explained by state differences in rates of return from schooling and in the inequality of years of schooling. The explanatory power of the model is increased to 85 percent (92 percent for white males) when the inequality in years of labor market experience and the relative inequality in weeks worked are added to the model. Similar patterns emerge in an analysis for the Canadian provinces.

It is often observed that the simple correlation between the level of economic development and the dispersion in labor market earnings across countries is negative once a certain (fairly low) level of development has been attained. This is consistent with the human capital model. The greater inequality of income in poorer countries appears to be due to their larger dispersion of schooling and, in particular, their greater rate of return from schooling. Income inequality across countries is highly correlated with the dispersion in years of schooling and the rates of return from schooling. Moreover, once these variables have been controlled, the observed partial correlation between income inequality and the level of development becomes insignificant.

2.5 *Education and the Distribution of Income: Changes over Time*

The human capital model of income inequality has also been applied to time series analyses for the United States (Chiswick and Mincer 1972). The data for the United States show no secular change in the relative income inequality of adult men in the period after the Second World War. To some, this is a paradox because the relative inequality of schooling (e.g., the coefficient of variation) has declined. The model indicates, however, that the relative inequality of income is a linear function of the absolute inequality (i.e., variance) of schooling. During the postwar period, the level of schooling increased dramatically, but the variance in schooling showed little change. Indeed, the stability in the United States in the postwar period of the rate of return from schooling, the variance of years of schooling, and the variance of years of labor market experience among adult men apparently "explain" the stability of the relative dispersion of income.

Studies for several countries show responses of the income distribution to cyclical changes in economic activity, disequilibria due to economic growth, and changes in the skill distribution of the labor force, all of which can be interpreted within the context of the human capital model. The inequality of annual income increases in a recession and contracts in a cyclical expansion, primarily due to changes in time worked during the year rather than changes in hourly wage rates. Since the rise in unemployment in a recession falls disproportionately on those with less schooling and less on-the-job training, rates of return from schooling and on-the-job training measured on the basis of annual income increase in a recession. Thus, cyclical changes in rates of return from schooling and postschool training are positively correlated with income inequality.

Periods of rapid economic change are associated with greater income opportunities for persons who are better able to identify and take advantage of these new opportunities. That is, "allocative efficiency" (decision-making skill) plays a more important role in a period of change than in a period of stagnation in which the best opportunities are known to all. Since one of the most important effects of schooling is to enhance allocative skills (Schultz 1975), rates of return from schooling and hence income inequality would tend to increase during a period of rapid economic change. This relationship has been observed in cross-national data for the income inequality of men living in urban areas (Chiswick 1974).

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Personal Earnings Variation and Education

J. W. Graham; W. W. McMahon

Two fundamental propositions appear to hold true across countries and across time: first, personal income is very unequally distributed; second, income and education are positively correlated. Over the past several decades economists and other social scientists have begun to link these propositions and ask to what degree the distribution of income in a society can be explained by its distribution of education. Most frequently this question has been posed for developed nations, and for the United States and the United Kingdom in particular, where cross section and time series personal income data are most readily available. While initial work focused on the effects of differences in schooling levels upon the distribution of earnings, more recent work has attempted to explain the basic causes of these differences in schooling.

This article will consider first, differences in earnings and property wealth as sources of inequality in the distribution of income; second, the relation of education to differences in earnings as developed by human capital theory and empirical research using earnings functions, screening, and life-cycle models; and third, causes of the differences in preschool training and formal schooling which lead to differences in earnings. It demonstrates that differences in the amount of education individuals receive is a major source of personal earnings differences. It will conclude with a consideration of public policies for the expansion of educational opportunity to reduce inequality and promote economic development.

The reader is also referred to related entries as well as to those entries dealing with nonmonetary returns.

Educational Cost Functions

D. W. Verry

This article begins by establishing that, at one level of abstraction, educational institutions can be thought of as producing units which transform inputs into outputs, incurring costs in the process. Then the nature of educational costs is explored in more detail, emphasizing the distinction firstly between private and social costs and secondly between average and marginal costs. The relevance of these distinctions for educational policy making is briefly discussed. The variation of costs with the level of output is examined both theoretically and empirically using the notion of the cost function. This is an analytical device borrowed from economics and its applicability to education is critically evaluated. In the latter sections a recurring theme is the importance of the fact that educational institutions produce not one but several outputs. This has implications for educational costing which are explored in some detail.

1. The Concept of Educational Production and Cost

Educational institutions transform inputs into outputs. Although this is a fairly empty statement until the objectives of the transformation process are specified, which requires definition of the outputs, it does highlight the fact that education can be thought of as production and educational institutions as producing units not totally dissimilar from manufacturing firms. To be sure there are important differences; schools, colleges, and universities do not generally seek to maximize profits, indeed they do not as a rule sell their outputs directly on the market (privately provided education will require some modification of these assertions). Nevertheless, like firms they take a set of inputs (teachers' and students' time, books, the service flow from capital assets such as buildings) and combine them in such a way as to produce a set of outputs (cognitive gains, socialization, new knowledge, etc.). Clearly this transformation of inputs into outputs is not costless, either in the sense of the monetary expenditures involved or, more fundamentally, in terms of the alternative opportunities that must be sacrificed to enable this transformation to occur. The teachers' and students' time, the buildings that they use, in fact virtually all of the inputs into educational production, have alternative uses, the value of the next best of which is their true cost (opportunity cost). In some circumstances, to be discussed further below, these costs can be measured by monetary outlays—expenditure on teachers' salaries, for example. Sometimes, however, market prices do not exist or, if they do, convey the wrong information about the value of inputs in alternative uses; then the costs must be imputed (examples are the forgone earnings of students in higher education and the capital cost of durable assets).

Since resource allocation in education does not result from the operation of market forces, some knowledge of the costs (and of course benefits) of producing different levels and mixes of educational outputs is required by those responsible for planning the growth and pattern of the educational system. In essence a continual series of explicit or implicit comparisons of costs and benefits ultimately determines the overall size of the educational budget, the broad allocation of that budget between the major educational sectors, as well as more detailed choices relating to curricula, class sizes, teaching methods, etc. Of course in practice most of these decisions have to be taken without full information about the relative costs of the alternative policies being considered (let alone about the more problematic benefit side of the calculation). In principle, however, knowledge of costs is as essential for rational decision making in education as it is in any other sector of the economy. Perhaps the reason why this is not more widely regarded as an uncontentious and self-evident truth is the fear that because educational benefits or outputs are so difficult to agree upon, let alone measure, relatively easily available information on costs is likely to dominate and hence distort educational decisions.

It has been argued that the importance of paying close attention to educational costs grows as educational expenditure takes a growing percentage of gross domestic product (GDP) (or of government expenditure) or during times of government expenditure cuts such as those imposed by the British government during the early 1980s as part of its anti-inflation policy. Strictly speaking this argument implies a direction of causation which is the reverse of that argued in the previous paragraph. According to the latter, cost–benefit comparisons would dictate the proportion of GDP devoted to education or dictate the level and nature of any required reductions in educational expenditure. Nevertheless it would seem to be a fact of life that educational expenditures are more carefully scrutinized the more quantitatively important they become and/or when they are being considered as a possible source of public-sector economies.

In the next section the principles of educational costing are defined.

2. Private and Social Opportunity Costs of Education

The cost of education to the individual pupil or student (or that individual's family) generally differs from the cost to society as a whole of that same education. This is likely to be true whatever level of education is being considered although the divergence between private and social cost will generally be greater the greater the extent of government subsidization of education. In many countries primary and often secondary education as well is completely free to the individual, being provided by the state. Direct private money costs will be limited to relatively small outlays on books, school uniforms, transport, and the like. Further, where such education is compulsory there is no private opportunity cost in the form of earnings forgone, a major item in the private cost of postcompulsory education (earnings and output forgone would be an important factor to be considered by a government contemplating raising the minimum school-leaving age). Primary and secondary education is of course usually financed from general income taxation so that there is, of course, an implicit tax cost to the student's family but this in most cases is indirect, unavoidable, and only weakly related, if at all, to the demands made on the education system by the taxpayer (tax payments by childless families contribute to the provision of primary and secondary education while tax payments by families with children may, due to child allowances, be inversely related to the demands they make on the school system).

But of course primary and secondary education provided by the state is not costless to society as a whole. It employs resources that have alternative uses. The value of these resources (more precisely the highest value placed by society on what these resources could produce in noneducational use) is the cost of education to society, even when it is provided free to individual users or consumers. Take the case of a primary-school teacher as an example. What that teacher costs society is the output that he or she could have produced elsewhere in the economy. Under certain conditions, mainly related to competitive labour markets, the value of that output will be reflected by the teacher's current salary. These conditions are not always fulfilled of course so that the current salary could either underestimate or overestimate true social opportunity cost. For example, if that teacher had no real alternative employment prospects, due either to the existence of general unemployment or because his or her skills had become so specialized in teaching that there was no demand for them elsewhere (at least in the short run, without substantial retraining) then the social opportunity cost of that teacher would be much less than the current salary; in the extreme, it could even be zero although this seems rather unlikely in practice. For postcompulsory education the availability of relevant employment opportunities affects both the private and social opportunity costs for students as well as teachers. By deciding to pursue full-time higher education a student is simultaneously deciding not to join the labour market. The cost of this decision to the individual is the posttax earnings forgone while to society it is the value of the sacrificed output. If that student would have been unemployed for some or all of the time actually spent in higher education then both private and social costs are correspondingly reduced.

Taxes as well as subsidies can cause private and social costs to differ. For example, the relevant opportunity cost for a student in postcompulsory schooling is the *after-tax* earnings forgone. Social cost however is the value of lost output. This is approximated (how closely depends on the extent to which market imperfections prevent wages and salaries measuring the value of the marginal product of labour) by *before-tax* earnings forgone. Similarly the private benefits of postcompulsory education are measured by after-tax earnings differentials plus any nonpecuniary benefits accruing to the individual, while social returns are the before-tax earnings differentials plus the value of any additional benefits to society at large which are not appropriated by the individual (externalities).

It has been argued above that genuine opportunity costs of education contain elements for which there is no corresponding direct monetary outlay. Thus private costs are not simply private outlays on education—the importance of earnings forgone as a major element of private cost has been repeatedly stressed. Similarly, social costs must include taxes forgone, an item with no corresponding expenditure of public funds, if the true cost of lost output is to be measured. Now it is perhaps obvious, but nevertheless worth stating, that the converse is also true, that is, not all monetary outlays are genuine opportunity costs. Thus a university student will spend considerable amounts on clothes, food, and accommodation during the course of study but these are not educational costs. Such maintenance expenditures would have been required even if that individual had not chosen to become a student; they would not have been avoidable by joining the labour market. Only in the unlikely event of university study requiring *additional* expenditures on such items would the *extra* expenditures be genuine educational costs. Similarly it needs to be stressed that not all public expenditures on education are social costs. For example, maintenance grants to students are *transfers* rather than opportunity costs, that is, they are income transfers from one group in society, earning taxpayers, to another, nonearning students. Such payments do not correspond to alternative opportunities which must be forgone as a result of educational provision. This is not to say that governments concerned with the level and allocation of public expenditure can ignore such transfer payments. They are not however opportunity costs of education. They do not represent a diversion of resources from the production of other goods and services.

3. Total, Average, and Marginal Costs

In the above discussion, in order to focus on other issues no attention was paid to the question of whether educational costs are best measured and expressed on a total, average, or marginal basis. The meaning of these terms is now considered in the context of education, as well as the dependence of costs on the level of output or scale of activity at which the educational institution (or the producing unit, however defined) operates. In order to prevent the terminology becoming too complex costs are not specified in what follows as being opportunity costs but they should be so understood. Neither is a distinction made between private and social costs. The concepts to be introduced can be applied to both private and social costs although the application of the following section is likely to be of greatest interest to educational decision makers concerned with the disbursement of public funds.

(a) *Total cost.* This is really a self-explanatory term, simply measuring the costs of all resources used at any particular scale of operation. In actual empirical studies total cost may refer to total *current* costs while in other studies *capital* costs may be included in the measurement of total cost. While capital costs pose some unique measurement problems in empirical work, they pose no particular conceptual problems at this stage, so the current–capital distinction is ignored.

It is fairly obvious that total cost will depend on the level of output (scale of activity). A school with 1,000 pupils will incur greater costs than one with 500 pupils; a university department with only 20 students will have lower costs than one teaching 200 students in the same subject. Note that in these examples "output" or "scale of activity" has been implicitly defined in terms of numbers of pupils or students. While this is almost universal practice in educational cost studies—especially empirical studies—it is obviously far from satisfactory. As a measure of output student numbers fail to capture the *quality* of the teaching output of schools or university departments even if they are a reasonable measure of quantity. Additionally, in the case of the university department the student number measure ignores the problem of multiple outputs. Universities produce at least two major outputs—teaching and research—and unless these are always produced in fixed proportions the scale of activity of a university department cannot be measured along only one of its output dimensions (schools also produce multiple products of course). The problems caused by joint or multiple products will be further discussed below, but for simplicity student numbers are used here as an index of the scale of teaching activity, not because it is an ideal measure but to enable us to proceed with our analysis of important cost concepts.

(b) *Average costs.* Average costs (or unit costs as they are sometimes called) are simply the total costs of producing a given level (or annual rate) of output divided by the number of units of output produced. So in the example above cost per pupil or per student is simply the total cost incurred by the school or university department divided by the number of pupils or students taught. Whereas it was fairly obvious that total costs increased with scale, it is not obvious whether average costs rise, fall, or are unaffected by the level of activity. The cost per pupil in the 1,000-~~pupil school~~ could be higher, lower, or identical to the unit cost in the 500-pupil school. Where average cost falls (rises) as output increases one talks of the existence of ***economies*** (diseconomies) ***of scale.***

(c) *Marginal cost.* This is defined as the increase in total cost resulting from increasing output by one unit (or, less rigorously, by some small amount). As with average costs it is not obvious how marginal cost varies with scale. Is the increase in total cost that results from enrolling an extra pupil greater, less, or no different in the 1,000-pupil school than it is in the 500-pupil school? Such a question can, in general, only be answered empirically.

4. *Cost Functions*

A convenient way to represent the dependence of costs on output or scale and to illustrate the relationship between total, average, and marginal costs is via the analytical device of the cost function. Letting TC represent total costs (per year, say, and measured in money terms) and S represent number of students or pupils, then the relationship between costs and student numbers can be represented by the function:

$$TC = f(S) \tag{1}$$

However, Eqn. (1) is too general to be of great interest. It certainly cannot show how average and marginal costs depend on scale. The cost function (1) must be expressed in a more specific form in order to answer such questions. A simple way of rewriting Eqn. (1) would be:

$$TC = \alpha_0 + \alpha_1 S \tag{2}$$

This equation tells us that in the particular school, department, or indeed in whichever educational production unit to which the equation is intended to apply, there is some *fixed cost*, or set-up cost, represented by α_0, which must be incurred irrespective of pupil or student numbers and that each additional student will involve the school or department in costs of α_1. Thus *variable costs* are given by $\alpha_1 S$, a magnitude which clearly depends on the scale of operation, S. Thus if we knew that $\alpha_0 = 2{,}500$, and $\alpha_1 = 100$, Eqn. (2) would tell us that the school or department has fixed costs of £2,500 and that each additional student adds £100 to costs. Thus, a school or department with 500 students

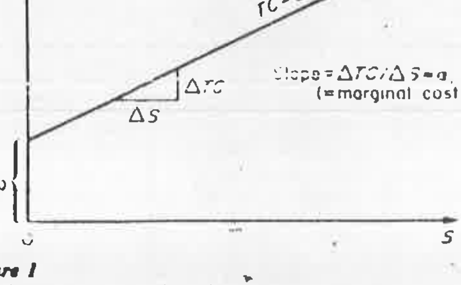

Figure 1
The linear total cost function

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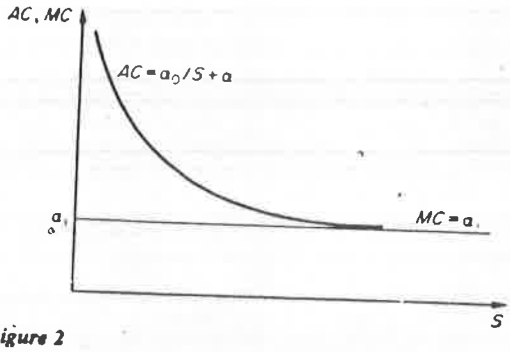

Figure 2
Average and marginal cost functions corresponding to the total cost function in Fig. 1

would have fixed costs of £2,500, variable costs equal to 100 × 500 = £50,000, and total costs of £52,500. Diagrammatically Eqn. (2) can be represented as in Fig. 1. This shows clearly that fixed or set-up costs equal α_0 when $S = 0$ and that, thereafter, total costs increase linearly at the rate of α_1 per extra student.

Equation (2) can be used to derive expressions for average and marginal costs, both of which are implicit in the total cost function. Average cost is simply total cost divided by output:

$$AC = TC/S = \alpha_0/S + \alpha_1 \qquad (3)$$

To find marginal cost from the total cost function (2), one must determine how total costs increase as S increases by one, for example from 500 to 501. Eqn. (2) shows that when $S = 500$, $TC_{500} = \alpha_0 + \alpha_1 500$ and when $S = 501$, $TC_{501} = \alpha_0 + \alpha_1 501$; thus $MC = TC_{501} - TC_{500} = \alpha_1$. [In this case the answer was obvious and the substitution was hardly necessary. With cost functions which are more complex than (2) MC may have to be so derived.] Note that with the cost function (2) MC is independent of output: the increase in total cost caused by the 501st student is the same as that caused by the 1,001st student, that is $MC = \alpha_1$ in each case. Average and marginal costs implied by Eqn. (2) are illustrated in Fig. 2. As can be seen from the figure, average costs fall steadily as student numbers increase: economies of scale are present. (Note: falling AC implies that MC is less than AC.) In this case for very large S, AC will be very close to MC; economies of scale are eventually exhausted. The economies of scale here are due solely to the spreading of the fixed cost element α_0 over ever larger numbers of pupils as S increases. The spreading of fixed costs is an important source of economies of scale in practice, but it is not the only source.

Equation (2) represented just about the simplest possible way in which costs can be made to depend on output. There is of course no reason to believe that such a simple representation is at all realistic. Equation (2) was just one way of specifying Eqn. (1) in a more precise form. But there are many other ways. Consider just one of these:

$$TC = \alpha_0 + \alpha_1 S + \alpha_2 S^2 + \alpha_3 S^3 \qquad (4)$$

which implies

$$AC = \alpha_0/S + \alpha_1 + \alpha_2 S + \alpha_3 S^2 \qquad (5)$$

and

$$MC = \alpha_1 + 2\alpha_2 S + 3\alpha_3 S^2 \qquad (6)$$

[Equation (6) is derived by differentiating Eqn. (4) with respect to S or by following the substitution procedure described above.] Again, there is a fixed cost of α_0 but now the increase in TC caused by enrolling an extra student is not constant but depends on the number of students already enrolled, as Eqn. (6) indicates. The marginal cost of the 501st student is no longer equal to the marginal cost of the 1,001st student. If α_0, α_1, and α_3 are positive and α_2 negative, the relationships in Eqns. (4), (5), and (6) are as illustrated in Fig. 3.

Here average costs fall with increases in student numbers up to $S = S_2$ and then begin to rise. Here economies of scale are due only in part to the spreading of fixed overheads. Up to the level of output $S = S_1$ marginal cost was falling, contributing to reductions in AC. Beyond S_1 however MC begins to increase (although AC will still be falling as long as MC is less than AC)

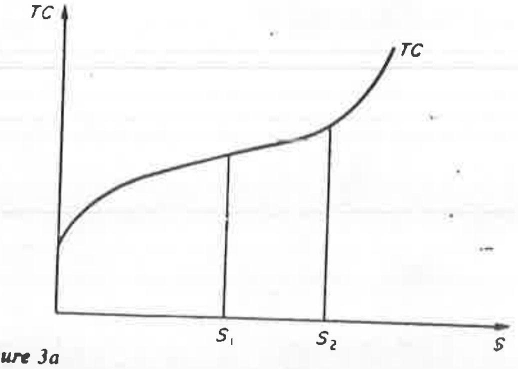

Figure 3a
The total cost function $TC = \alpha_0 + \alpha_1 S + \alpha_2 S^2 + \alpha_3 S^3$ (α_0, α_1, $\alpha_3 > 0$; $\alpha_2 < 0$)

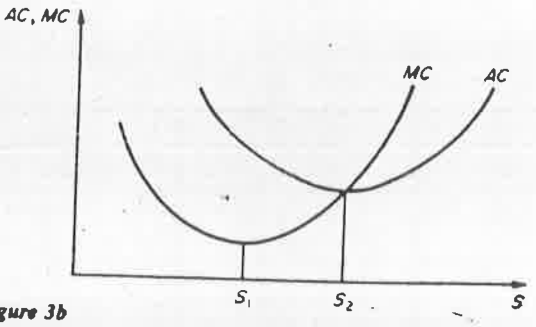

Figure 3b
Average and marginal cost functions corresponding to the total cost function in Fig. 3a

and these increases will eventually, at S_2, offset the reduction in unit costs due to the spreading of overheads. Beyond S_2 increasing MC becomes the dominant influence, economies of scale are exhausted, and unit costs begin to increase.

Having introduced the basic concept of a cost function and the concepts of average and marginal costs, we now illustrate how these concepts may be used in educational decision making, using a very simplified hypothetical example, which nevertheless has enough basic similarities to real problems confronted by policy makers to be instructive. A common policy problem is how to plan efficiently for additional pupils. Suppose that some local school district finds itself having to cater for an additional 500 pupils and that it already has two schools, A and B, in existence. Educators inform planners that the manner in which the extra pupils are distributed between the two schools will not materially affect the quality of education received by the existing or new pupils. This reduces the problem to one of minimizing the costs of teaching the extra pupils. Suppose that it is also known that in both schools the relationships between cost and output were given by a single cost function such as Eqn. (2) above, but that school A currently has few pupils while school B is large and has lower average costs per pupil because its overheads are spread over more pupils. This initial situation is illustrated in Fig. 4. Should the extra 500 pupils be allocated to school A or school B (or spread between them)? One answer might be that school A should take the extra pupils so that it can reduce its unit costs to an "economic" level. Alternatively it could be argued that school B should take the extra pupils because it can teach them at lower average cost. Both of these arguments are encountered when such decisions are under consideration. But both are wrong. What is relevant for an expansion decision of this kind is not average but marginal cost, and in our example both schools incur the same marginal cost per additional pupil, i.e. £α_1. Thus on cost grounds it is a matter of complete indifference which school takes the extra 500 pupils. In either case the extra cost will be £(α_1.500). As long as both schools are going to continue in existence the fact that they have different average costs is totally irrelevant. This conclusion depends crucially of course on the nature of the cost function assumed. Let us examine the implications of varying this assumption. To do this suppose now that both schools have a cost function like that of Eqn. (4) and Fig. 3, and are initially located at S_A and S_B in Fig. 5. Once again marginal costs are relevant for the expansion decision. So it is clear that in spite of having higher average costs school A should take the extra 500 pupils because it has much lower marginal costs and will thus incur much lower increases in total costs than would school B if it took the extra pupils.

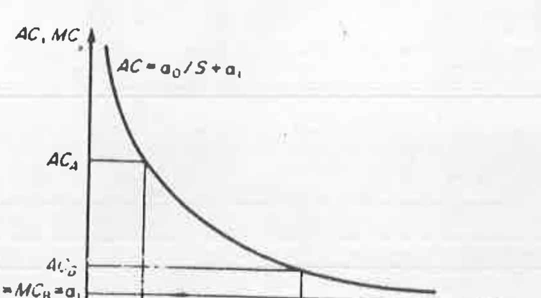

Figure 4
The average cost function $AC = \alpha_0/S + \alpha_1$ (α_0, $\alpha_1 > 0$)

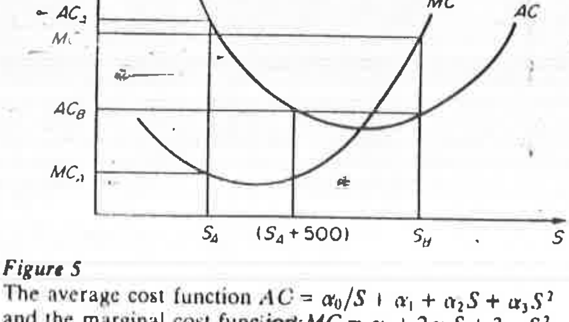

Figure 5
The average cost function $AC = \alpha_0/S + \alpha_1 + \alpha_2 S + \alpha_3 S^2$ and the marginal cost function $MC = \alpha_1 + 2\alpha_2 S + 3\alpha_3 S^2$ (α_0, α_1, $\alpha_3 > 0$; $\alpha_2 < 0$)

An option not considered in the above analysis was building a third school, C, to take the extra 500 pupils. Would this be a cost-effective policy? Again, the answer depends on the kind of cost function assumed and the initial sizes of schools A and B. With cost function (2) it would *never* be efficient to build a new school. Such a policy would incur additional set-up costs of £α_0 as well as the £(α_1.500) that it would cost either school A or B to take the extra pupils. (In fact the existence of these two schools implies an inefficient choice in the past; amalgamation would save one set of fixed costs.) If cost function (4) was relevant the new school option could be efficient. Although a further £α_0 of fixed costs would be required, a third school could still be the cheapest option if both existing schools had much higher marginal costs than the new school would incur at relatively small scale. To check this possibility one could *not* just look at marginal costs; the whole cost function would have to be used to check each option. Ignoring the possibility of mixed strategies of spreading the additional 500 pupils between the three schools (although this possibility could be examined in essentially the same way) the decision maker would compare the following three magnitudes and choose the cheapest: (a) $(TC_{A+500} - TC_A)$. This is the cost of teaching the extra 500 students in school A (TC_A being total cost in school A before expansion); (b) $(TC_{B+500} - TC_B)$, the cost of expanding school B; and (c) TC_{500}, the cost of the new school option. (If this option were the cheapest and the new school were built, similar calculations might reveal cost savings from transferring some pupils from schools A and/or B to the new school.)

5. *Joint Costs*

If the analogy of the manufacturing firm which began this entry has any validity for educational institutions then the parallel must surely be with the multiproduct firm rather than with a firm producing a single output; schools produce cognitive and noncognitive outputs, universities produce teaching and research, etc. More detailed discussion of the nature of multiple products in the context of education appears elsewhere in this encyclopedia. Here an attempt is made to examine the implications of multiple products (or, synonymously, joint production) only for the principles of educational costing. How should this discussion, which up to this point has been in terms of a single output (proxied by student numbers), be modified to allow for joint products? The basic principle of opportunity cost of course remains intact, although measurement of opportunity cost may become more difficult, as explained below. Similarly the potential divergence between private and social costs is essentially unaffected, except to note that within any institution or educational sector the extent of any private–social divergence need not be uniform for the different outputs being produced. Depending on the benefit side of the calculation this could require governments to offer differential subsidies for the production of the different outputs. However, the real problem caused by joint production arises in relation to a different issue; can separate costs be identified for the separate outputs? It is just conceivable, but rather improbable, that multiple products could be produced within educational institutions using completely separate production processes in which each input contributed to one and only one output. Much more likely, however, is the case where some inputs are common to the production of two or more outputs; university buildings, central administration, libraries, etc. support both the teaching and research functions, time spent by university lecturers "keeping up with the subject" improves the quality of both teaching and research, research activity itself can improve teaching while teaching also has some feedback to research (highlighting major deficiencies in the current state of knowledge, for example). The above examples imply complementarity between production of the different outputs; research activity improves the quality of teaching and/or reduces required teaching inputs. However, the relationship could be one of competition rather than complementarity; excessive research zeal could lead to neglect of teaching or vice versa.

Where there is genuine joint production (rather than essentially independent activities carried on under the same roof) there will be one or more common inputs whose costs cannot be fully allocated in any nonarbitrary way to the joint outputs they produce. Indeed the question of how to allocate joint costs to separate outputs/products, although often asked, is an essentially misconceived and irrelevant question. This has not prevented various solutions being advanced to this "nonproblem". For example, where *some* costs in a joint production enterprise can be allocated it is sometimes suggested that common costs should be allocated in the same proportion, although there is of course no reason why the proportions of separable costs should also apply to joint costs. Where outputs are marketed (to take a noneducational example, the freight and passenger services of an airline) it has been suggested that common costs (fuel costs) should be allocated in proportion to sales (revenue from freight and passenger carriage). Again, however, this is an essentially arbitrary procedure; allocation is simply not possible in the case of common inputs. We can go further, however, and assert that not only is such allocation impossible but also that it is never necessary; no real purpose is served by such an exercise. Before justifying this assertion it is necessary to relate the above discussion about the impossibility of allocating joint costs to separate outputs to the distinction between average and marginal costs. This enables us to be somewhat more precise about the extent to which allocation is possible. In particular, while it is impossible to derive separate average (and hence total) costs for jointly produced outputs, it usually *is* possible to calculate separate marginal costs. So long as it is possible to increase the output of only one of a number of joint products, holding constant the level at which the other outputs are being produced (this assumption rules out the case where joint outputs must always be produced in fixed proportions) then one can observe the increase in total cost that results. This yields the marginal cost of that product, at the given output levels of the other products (this latter qualification is necessary because the marginal cost of one of the number of jointly produced products is itself likely to depend on the concurrent production levels of the other outputs). Thus, although teaching and research are joint products, the marginal cost of teaching an extra student, holding the level of research output constant, can in principle be calculated.

Returning to the assertion that one never needs to allocate total or average costs between products which are jointly produced, this becomes self-evident for the costing of marginal expansions or contractions. Here marginal costs are relevant and they can be calculated—there is no need to attempt the impossible task of allocating total costs or calculating separate average costs. Now it is, of course, true that nonmarginal decisions are often encountered, in education as elsewhere.

An example might be where the establishment of a completely new university department, doing both teaching and research, was contemplated. But again one would not wish to do separate cost–benefit analyses to see whether the teaching and research were individually desirable. Rather one would compare the costs and benefits of the total teaching and research package. Separate total or average costs for the two outputs are not required.

Some of these points can be illustrated using the cost function. Consider the following function:

$$TC = \alpha_0 + \alpha_1 S + \alpha_2 R - \alpha_3 S^{\frac{1}{2}} R^{\frac{1}{2}} \tag{7}$$

where S represents teaching output and R research output. Although this equation looks rather odd it is probably the simplest mathematical form which sensibly captures joint effects. Note that with this cost function one cannot simply divide through by S (or R) to get average teaching (research) costs. One obvious objection to this procedure would be that the very first term on the right hand side, α_0/S (α_0/R), would allocate all of the set-up costs to teaching (research). There are no separate TC or AC functions for teaching or research. But now consider marginal costs:

$$\text{Marginal teaching cost} = \frac{\partial TC}{\partial S} = \alpha_1 - \tfrac{1}{2}\alpha_3 \left(\frac{R}{S}\right)^{\frac{1}{2}} \tag{8}$$

$$\text{Marginal research cost} = \frac{\partial TC}{\partial R} = \alpha_2 - \tfrac{1}{2}\alpha_3 \left(\frac{S}{R}\right)^{\frac{1}{2}} \tag{9}$$

With α_1, α_2, α_3 all assumed positive, these equations show that the marginal cost of teaching (research) is some constant amount, $\alpha_1(\alpha_2)$ minus some amount which will be greater the greater the ratio of research to teaching (teaching to research).

6. Empirical Studies of Educational Costs

The above analysis concentrated on analytical principles of educational costing, suggesting the type of cost information required by educational decision makers and the proper use to which it could be put once acquired. If these principles are not understood the wrong information will be collected or correct information misused. Equally, however, these principles, even if perfectly understood, are of little use to those entrusted with taking educational decisions in the absence of actual cost data. In fact educational costs have been the focus of considerable empirical research by applied economists and others more directly involved in educational administration. There is little point here in attempting to survey these studies or present actual quantitative results; cost figures quickly become dated and in any case the results of cost studies made in the context of a particular type of educational system may be almost totally irrelevant in a different educational system. So this section concentrates on discussing the main types of cost study that have been done, highlighting methodological issues rather than actual results, although a sample of these can be found in the bibliography.

Naturally enough the appropriate type of empirical cost study is determined by the question being asked, the policy option being assessed. For example, in rate of return studies for postcompulsory education, a major cost item that must be quantified is the forgone income of students, while this item is of little interest where the focus of attention is the efficiency of educational institutions, singly or as a system. Similarly if planners were concerned with the problem of ensuring an adequate supply of qualified teachers one would have to pay particular attention to the expected trend in salaries, job satisfaction, promotion prospects, and so on in the teaching profession compared to those in alternative occupations which might be chosen by potential teachers. Such factors however could, in general, be safely ignored—even though teacher salaries may be a major cost item—in examining the relationship between cost and output.

The remainder of this section concentrates on the latter type of study (cost and scale), as this relates most closely to the previous discussion, and in particular how one might try to learn what the cost function looks like in practice. The cost functions in Eqns. (1)–(9) above, and in the figures, were of course purely hypothetical. If however one knew what the *actual* cost function looked like [if, for example, one knew the actual values of α_0, α_1, α_2, and α_3 in Eqn. (7)], one would then have a rather powerful method of providing policy makers and educational planners with information about the relationship between costs and scale. In the university teaching and research example one would then know the level of marginal cost of both outputs and how the marginal cost of either output varied with the scale of its own production and/or that of the other output. If joint production proved not to be an important feature of real educational production then by attaching actual values to the αs in an equation such as Eqn. (4) one would have information not only on marginal costs and their variation with scale, but on average costs as well.

In practice, two basic approaches can be followed in finding the relationship between cost and scale (or output). In the first, detailed institutional knowledge and data are used to *construct* the cost function. In the second, statistical techniques are used to *infer* the cost function from observations of costs and outputs in different institutions. Each approach is now discussed briefly using university costing as an example, but the techniques described can be used (and have been) to analyse costs in other types of educational institutions (schools), and indeed in noneducational institutions as well.

The first approach (Bottomley 1972) depends on having detailed knowledge of the working of a particular institution. More specifically one needs to know the capacity of the institution or department under scrutiny and the costs of changing that capacity. In turn this requires knowledge of the size of lecture halls, the number of library places, the ability, expertise, and flexibility of teaching and support staff, as well as expert judgments about such questions of educational technology as what is the maximum size of lectures and tutorials beyond which teaching quality suffers. Armed with such detailed knowledge about the institution one could construct a cost function as in Fig. 6.

In contrast to the smoothly continuous cost function of Fig. 3a the total cost function in Fig. 6 is stepped, with steps or "jump points" occurring when lectures or classes have to be duplicated (either on educational grounds or due to space constraints) or when extra staff (teaching or administrative) have to be hired and new equipment purchased. Between these jump points the marginal cost of an extra student may effectively be zero, as extra students simply fill up spare capacity in existing lectures and classes, use existing equipment, and so on. But at some level of student numbers decisions will be taken to duplicate lectures or classes, hire an extra teacher or secretary, and so on and there will be sharp discontinuities in total cost (these discontinuities occur at points S_1, S_2, S_3, and S_4 in Fig. 6).

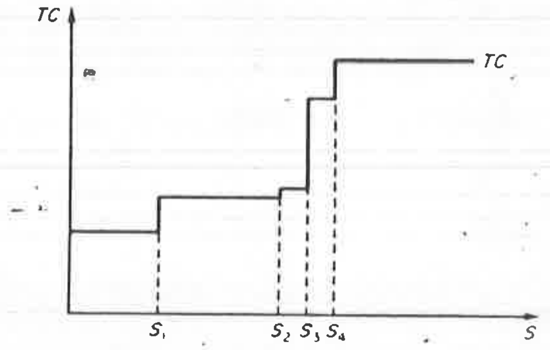

Figure 6
A constructed total cost function

The principal appeal of this institutional–descriptive approach lies in its exploitation of the expertise of those actually involved in the institution being studied. After all, it can be argued, who better understands the implications of decisions to alter the scale or product-mix of an institution or department than its own teachers and administrators? Neither civil servants in central government departments nor hastily recruited economists or management consultants can be expected to have a comparable understanding of the relevant institutional structure and educational requirements. The disadvantages of the approach on the other hand are simply the mirror image of these arguments; the direct involvement of an institution's personnel may distort the costing exercise by introducing vested interests, internal rivalries, idiosyncratic beliefs about teaching methods, and so on. More fundamentally, one must consider how the results of such an exercise could be used and in particular whether the results can be generalized to other institutions. If they are too institution-specific to be capable of such generalization such studies will be useful for purposes of monitoring and improving the internal efficiency of the university in question but of little help for costing proposals and trends at a more aggregated level.

Such problems are best analysed using the second of the two methods—statistical, or econometric, estimation of cost functions (Caves et al. 1980). The basic approach here is to collect paired observations of costs and student numbers (or whatever measure of scale is being used), one such pair for each institution, and to use regression analysis to derive from these observations the parameters of the underlying cost function which is assumed to be common to all institutions for which data are available. In short an attempt is made to estimate the real-world values of the α's in a cost function such as that represented by an equation like (4) or (7) above. Such an approach, while potentially extremely useful, is beset with many difficulties, some of the more important of which are now discussed briefly.

6.1 Choice of the Unit of Analysis

The first decision to be taken by the empirical researcher is which unit of analysis to use when estimating cost functions. Should observations of costs and outputs apply to whole universities or to some smaller grouping such as the faculty or department? Sometimes the form in which the data are available will dictate this choice, but where alternative breakdowns of the data are feasible one ought to try to choose as the unit of analysis the basic decision-making unit. In the case of universities this may be the department (although of course some decisions will be taken by the central university administration and others at the faculty level). Thus one would take observations of costs and outputs in, for example, English departments in a number of universities and then estimate a cost function for English teaching and research. Using this methodology one would either estimate a separate cost function for central university costs (the university being the unit of analysis) or else attempt to allocate such central costs to individual departments.

6.2 Choice and Measurement of Variables

Having chosen the unit of analysis, the variables to appear in the cost function must be defined and measured. Beginning with the dependent variable, cost itself, the actual data available will invariably be in the form of educational expenditures. Whether expenditures can be interpreted as costs is further discussed below, but in practice the researcher really has little choice but to use such data. There is an element of choice, however, about *which* expenditures to use as the dependent variable; total capital and current, current only, or some subcategory of current expenditures such as those on academic staff. Cost functions can be estimated for any or all of these cost/expenditure categories.

Measurement of the independent variables, that is, the output or scale variables, is of course one of the most difficult problems to be encountered in empirical analysis of the economics of education. Mention has already been made of the shortcomings of student numbers as the measure of teaching output. Measurement of research output poses different, but equally thorny problems.

6.3 Choice of Functional Form

Confronted with a data set of matched observations on costs and scale one must then settle on the type of equation to use in estimation. Should it be linear, as Eqn. (2) (with an extra term added to capture the cost implications of research, i.e., $TC = \alpha_0 + \alpha_1 S + \alpha_2 R$) or nonlinear like Eqn. (4) above (again with added terms in R and possibly R^2 and R^3 as well)? Should interaction terms be included to test for interdependence in production [Eqn. (7)]? [Note that Eqn. (7) is only one possible functional form that can be used to investigate joint costs. More general, unrestricted functional forms are available to estimate the structure of costs in multiproduct enterprises.] In making these decisions the researcher will generally experiment with the data, trying alternative functional forms and testing the statistical significance of certain variables [for example, whether the inclusion of S^2 and S^3 improves the "fit" of the estimated equation compared to the estimated version of Eqn. (2), or whether the estimated values of α_2 and α_3, the coefficients of the variables S^2 and S^3 in Eqn. (4), are statistically significant]. The choice of functional form must also be dictated, however, by the a priori reasonableness of its cost implications. Just one example of a functional form likely to be rejected on these grounds is $TC = \alpha_0 S^{\alpha_1} R^{\alpha_2}$ which, while it may capture the interaction between teaching and research, has the unrealistic implication that if either S or R is zero so is total cost.

6.4 Interpretation of the Estimated Function

The cost function of standard economic theory specifies the *minimum* cost of producing any given output, or combination of outputs in a multiproduct firm. Clearly the educational policy maker would also like to be able to give this interpretation to estimated educational cost functions. After all it is obvious that extra output could cost almost anything depending on how efficiently or inefficiently it is produced. But in comparing different educational projects policy makers wish to know the costs of the educational projects in efficient (or at least averagely efficient) institutions. Whether the estimated functions described provide this information depends on how the data, that is, the observations on costs and outputs used to estimate the cost function, are generated within the institutions to which they apply. If within such institutions there exist incentives to produce outputs at minimum cost then the cost function estimated from expenditure data will have the desired interpretation. If on the other hand university departments have funds dispersed to them according to some rule of thumb (e.g., by some per student capitation grant) then departments will usually simply just spend these funds (they may even be penalized for not doing so) and the estimated relationships between expenditure and outputs will simply reflect this rule of thumb used for allocating funds. The estimated cost function would not in these circumstances tell us the true marginal opportunity costs of expanding teaching and/or research in a given subject. The extent to which estimated cost functions in education can be taken as representing the minimum costs of producing given outputs is still an open question. The assumption that educational institutions act as cost minimizers is not absurd; after all the teachers and administrators in such institutions do have certain objectives and are constrained by limited resources, so that departures from cost minimization imply that whatever objectives are being pursued will not be attained to the full extent possible. Nevertheless it cannot be denied that there exist counterincentives within education institutions which may work against cost minimization. The true interpretation of estimated relationships between expenditures and outputs in educational institutions must await improved models of the behaviour of nonprofit organizations (Baumol and Bowen 1966). Such models may provide a clearer picture of how expenditure and output data are generated, enabling in turn a less ambiguous interpretation of the estimated relation between them.

These problems of estimation and interpretation notwithstanding, the econometric approach to deriving educational cost functions can contribute extremely useful information to decisions about expansion or contraction of the education system at the sectoral (primary, secondary, tertiary) level. Being derived from information from many institutions with different characteristics such functions essentially smooth out the "jump points" of each individual institution's cost function, providing an average relationship giving, for example, the marginal cost of expanding student numbers in a representative institution, which is the information required when a planned or forecast expansion cannot be directed to or located in a particular institution but is likely to be spread across institutions in approximately the proportions in which students are currently enrolled in those institutions. A further advantage of the econometric approach relates to the allocation of joint (marginal) costs to different outputs. Compared to the descriptive–institutional approach, where such costs must be allocated by essentially arbitrary rules or institution-specific judgment (possibly locally accurate but unlikely to be generally so), the econometric approach exploits actual data on the joint variation across institutions of cost and outputs to derive separate marginal costs for the jointly produced outputs.

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International Educational Expenditures

J. W. Graham

Evidence on international differences in educational expenditure is limited generally to data on public expenditures. The developed nations of Europe and the Americas spend significantly more than the developing nations of Africa and Asia, although differences have begun to narrow slightly. For the world as a whole, per capita public education spending in 1978 was US$146, or 5.6 percent of world gross national product (GNP).

1. *Data Availability*

The most complete set of statistics on international educational expenditures is compiled and published by UNESCO. Their *Statistical Yearbook*, published annually, provides data on educational expenditures of approximately 200 nations and territories, based upon official replies to UNESCO questionnaires and special surveys. These data refer solely to public expenditure on education—that is, government-financed expenditures for public education plus subsidies for private education. Private expenditures on education are not published by UNESCO because few nations gather such information. It is possible to compare private consumption expenditures allocated to education for member nations of the Organisation for Economic Co-operation and Development (OECD)

2. *Public Expenditures on Education*

Tables 1 and 2 summarize statistics on public expenditures on education for specific regions and countries. Table 1 groups nations by continents as well as development status in offering comparative expenditure data for 1965 and 1978. Spending totals are presented both as a percent of GNP and on a per capita basis expressed in United States dollars. According to these data, total

Table 1
Public expenditures on education 1965 and 1978[a]

	Percent of GNP		Per inhabitant (in US$)	
	1965	1978	1965	1978
World	4.8	5.6	38	146
Africa	3.4	4.8	6	29
America (North and South)	5.1	6.0	94	291
Asia	3.5	5.0	7	55
Europe (including the Soviet Union)	5.0	5.7	63	271
Northern America[b]	5.4	6.6	187	622
Latin America[b]	3.0	4.0	13	60
Developed nations[c]	5.1	5.9	86	366
Developing nations[c]	2.9	4.1	5	26

a Source: UNESCO *Statistical Yearbook 1981* Table 2.12 b Northern America includes Bermuda, Canada, Greenland, St. Pierre and Miquelon, and the United States. Latin America includes the rest of America c Developed nations include all European countries, the Soviet Union, the United States, Canada, Japan, Israel, Australia, and New Zealand. Developing nations are the rest of the world excluding South Africa, People's Republic of China, Democratic People's Republic of Korea, Laos, and Vietnam

Educational Financing

C. Benson

Education in almost all countries is provided in both the private and public sectors. Education, thus, is not a purely public good; the exclusion principle, barring students who fail to pay fees to a particular educational institution, can be readily applied (even though it rarely is applied in the lower grades). Education consumes a significant amount of resources in almost all countries, running between six and ten percent of gross national product. A certain minimum level of educational provision is generally assumed to be necessary in order for a country to attain a reasonably high rate of economic growth. The distribution of educational opportunities to different groups of the population has consequences for social justice. As a result of the size of the set of educational activities in a country, and because educational provision affects economic growth and the distribution of income, systems of educational finance are likely to be complicated. The complexity is reinforced by the fact that education is carried forward in both the public and the private sectors and might best be described as a quasipublic good.

There are three main criteria by which systems of educational finance are traditionally judged: whether the level of provision of educational services is adequate; whether the distribution of educational resources is efficient; and whether the distribution of educational resources is equitable. These three criteria are interrelated.

1. *Adequacy of Funding*

During the 1960s and the first half of the 1970s, adequacy was defined in terms of the percentage of gross national product devoted to education (the figure of eight percent was often deemed "adequate"), and in terms of the share of the central government's budget spent on education (20 percent was an appropriate figure). These kinds of measures are not thoroughly satisfactory because they sometimes ignore private education and educational revenues generated in provincial and local authorities. Their meaning was also ambiguous because they failed to address the question of the efficiency with which a given government ran its educational programs.

Since the late 1970s, following the leadership of the World Bank, a new set of adequacy measures has come to be accepted. These measures are intended to get somewhat closer to outcomes of educational systems. One measure is the proportion of the relevant age group enrolled in primary school (in Ethiopia a figure of 26 percent was reported in 1977; in the same year in Turkey, it was 98 percent). A second set of measures relates to balance by sex, that is, whether educational opportunities are provided to women (in Morocco, 86 percent of the age cohort of males were enrolled in primary school but only 50 percent of females). A third criterion of adequacy is the proportion of the age cohort enrolled in secondary school (in the industrialized nations, this runs from 70 percent to over 90 percent; in the poorer nations, a figure of around 20 percent is typical). A fourth criterion is adult literacy rate (the industrialized nations report no adult illiteracy to speak of, with literacy rates being typically at the 99 percent level; poorer nations have literacy rates of 50 percent or less, generally speaking).

To assure (a) near-universal enrollment in the elementary grades, (b) sufficient retention in the elementary grades to supply a sizable and sexually balanced group of students for the secondary grades, and (c) a quality of instruction for the whole population to sustain lifelong literacy, it is demanded that teachers and classrooms be generously available in both cities and rural areas. The objectives by which adequacy of education is defined also require at least a minimum level of competence and commitment on the part of teachers. The requirements for real resources to meet standards of adequacy set, in turn, the financial requirements. Required cost per capita will vary from country to country, depending on the degree of efficiency with which the educational system is operated.

For the industrialized nations and nonindustrialized countries characterized by a relatively equal distribution of income, the question of adequacy needs no further general discussion. However, when a large part of the youth population of a country is affected by malnutrition, or poor health, or where many parents find it necessary to exploit the labor of their very young children, then an "adequately financed" system of education, as defined by conventional standards, may fail to yield the objectives of educational adequacy (near-universal primary enrollment, sex balance in secondary schools, high rates of adult literacy, etc.) mentioned above. It may be necessary to expend public resources to protect the nutritional status, health, etc., of students and intending students in order that they be physically able to benefit from the instruction offered to them in an "adequately financed" educational system.

Like an international airline, a university system is an indispensable symbol of status the world over. It is generally expected that universities will be financed at some level beyond the requirements of the economy to provide itself with liberal-arts graduates and lawyers. When adequacy is viewed in terms of less glamorous sectors of higher education, such as polytechnical institutes, the condition is often different. Many countries fail to provide themselves with sufficient graduates in technical fields, a problem that could be ameliorated by adjusting program enrollments to manpower requirements projections.

2. Efficiency

Publicly financed institutions, whether at the school, technical institute, or university level, ordinarily claim a certain degree of autonomy in managing their affairs. In some instances, institutional views of educational policy may be contrary to the dictates of efficiency, as seen from a national perspective. There are two main criteria for judging efficiency in education: cost–benefit and cost–effectiveness. To raise standards of educational efficiency, it is necessary that central governments use the power of the purse string to shape local policy.

The cost–benefit ratio can be reduced (implying an improvement in efficiency) by reducing cost while holding output constant or by seeing to it that graduates at any level have been prepared, or are being prepared, to maximize the present discounted value of their lifetime income streams.

In free market economies, it might at first seem that one could leave the problem of income maximization in the hands of the individual student. However, it is not always true that the market, even where it is competitively organized, gives sufficient heed to long-term needs for trained personnel. Hence, for example, the government might judge that the country was offering excessively high rewards to business managers and inadequate rewards to scientists and engineers, with the result that the country was in danger of losing whatever degree of technological superiority it had attained. The government might then offer grants to postsecondary institutions for improvement of their science and engineering facilities and it might offer additional fellowships in these fields while cutting back on fellowships provided to students in management fields. Use by the government of financial incentives to produce a relative shift of real resources among specialties in postsecondary institutions may be unavailing, however, if the basic salary structure in the economy is unyielding (if, for example, employers continue to give preference in pay to managers over scientists and engineers). This illustrates the point that improvements in educational efficiency may require exercise of economic power beyond that which is held within the educational community itself.

Another type of cost–benefit problem may be more amenable to government policy: for example, if it is determined that rural youth are being provided a lower standard of educational provision than city youth, and that the educational deficiencies in the countryside prevent graduates of rural institutions from making their full contributions in the economy. The government might then use its financial powers to improve the physical facilities of rural schools and it might offer salary supplements to well-trained teachers who might be induced to work in rural schools. A similar problem occurs when the education of females is slighted, with the result that a country can be deprived of the services of up to half of its human talent. The government, seeking to change such a condition, might give special grants to institutions that enroll women in nontraditional fields, and it might offer extra fellowships to female applicants. The government may redirect resources toward these target groups—it has that power—but it may also need to follow up and put pressure on private employers to hire graduates of rural schools and to hire women to work in nontraditional roles.

It is necessary to consider cost efficiency and how efforts to raise the cost effectiveness of an educational system might be reflected in a government's financial policy. Cost effectiveness refers to the yield of educational outputs relative to consumption of real resources by educational institutions. Lapses from an acceptable standard of efficiency generally take one or more of the following forms:

(a) an excessive rate of student wastage;

(b) an excessive rate of student repetition of classes;

(c) a high rate of student failure in examinations (whether as actually recorded, or as perceived by potential employers); and

(d) a progress of instruction which is too slow and drawn out.

Student wastage, repetition, and failure, may have a number of different causes, and the causes may be different from one institution to another and from one region to another. To attack these problems by using financial incentives requires a government to have a good management information system and a certain freedom from political influence. In the lower grades, children in rural areas and in urban slums may drop out of school or study poorly on account of problems of health and diet. In postsecondary institutions, problems of student performance may reflect primarily the condition that students were not well-prepared for academic studies in the feeder institutions they attended. In some countries these difficulties appear to be massive in scale, and the government then faces a choice of trying to do a little for all the students who are in academic difficulty, or to marshal substantial resources to help students in certain development zones or pilot projects, leaving the rest to wither on the vine.

3. Equity

The effects of a search for equity in the design of most systems of educational finance are so strong and the approaches to finance of primary and secondary schools, on the one hand, and to finance of postsecondary institutions, on the other, are sufficiently different that it is necessary to distinguish clearly between those two main sectors of education.

In the administration of primary and secondary schools, most central governments seek an arrangement which is neither wholly centralized nor wholly decen-

There are two main approaches to the problem of equity in finance of higher education. In Europe and in most developing countries, the central government pays most of the costs of postsecondary education, including student maintenance, and the necessary funds are distributed directly to the institutions. The systems are hierarchical, topped by one or more major universities, and grounded in various forms of technical institutes and institutions of further education. The intending student finds a place in the structure in accordance with his or her measured academic abilities.

In the United States, the main support of higher education is found in a system of grants and loans made directly to students. The size of individual grants is related (inversely) to parental income. The student is free to use the grant/loan in any approved institution to which he or she can gain admission. The United States approach is more conducive than the European it would seem, to privately administered expansion of higher education and to "openness" of admissions. However, some observers express concern about academic standards in the lower tier of institutions in the United States.

Periodically, there is interest in shifting the cost of United States higher education from government and parents to students themselves, using the device of "income-contingent loans." Through those loans students could borrow practically unlimited sums for their education and pay the money back over their working lifetime, relative to the extra income that is estimated to be attributable to their additional schooling. Under conservative fiscal policy and high rates of inflation of costs of higher education, devices of this kind may well be adopted.

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School Finance

H. M. Levin

A national commitment to schooling requires that a method be established for obtaining and allocating resources for education. School finance refers to the process by which tax revenues and other resources are derived for the formation and operation of elementary and secondary schools as well as the process by which those resources are allocated to schools in different geographical areas and to types and levels of education. Although school finance is closely related to higher educational finance, important differences in institutional contexts generally require the separation of elementary- and secondary-school finance from postsecondary educational finance. Accordingly, the term school finance has generally been limited to the elementary and secondary schools and, in some cases, preprimary education.

The area of school finance draws heavily upon a variety of concepts and theories from other fields. Since laws must be passed and administered, it is closely related to the politics of education and educational law. Since various aspects of economics and finance are involved, it must draw upon principles from the economics of education and government finance. And, since the overall plans for financing education must be translated into the operations of schools, it must necessarily relate to school administration.

It is important to provide brief definitions of a number of terms that are commonly used in school finance. School revenues refer to the financial receipts of schools for supporting their operations. Such revenues can be derived from taxation, tuition charges, and student fees as well as from contributions and income from the provision of goods and services. School expenditures refer to the financial disbursements of schools for the purchase of the various resources or inputs of the schooling process such as administrators, teachers, materials, equipment, and facilities. Costs represent the value of all resources used in the schooling process whether reflected in school budgets and expenditures or not. The costs of school resources include the values of any inputs that are used, even if they are donated or not reflected accurately in expenditure accounts.

Because of the fundamentally different nature and financing of capital and operating expenditures, it is useful to differentiate between them. Capital expenditures are those incurred for providing school plant and facilities. Although capital investments require a large initial expenditure, the plant and facilities have a lifetime that extends over many years. In contrast, operating or recurrent expenditures refer to financial outlays for school resources that are used each year for the operations of the schools, such as teacher salaries and disposable supplies. Budgetary provisions must be made for operating expenditures each year.

School finance begins with the major decisions about education, such as who will be educated and in what ways. The financial aspects must necessarily be based on the translation of these decisions into resource requirements, which will be satisfied through tax revenues, family expenditures, and donated resources. In any society, the nature of educational finance issues will be determined by the types of educational decisions and commitments that are made. Since these will differ substantially from society to society, so too will school finance arrangements.

For example, the issue of educating handicapped youngsters is central in some societies, while in others it is not. Accordingly, school finance will address the problem of financing education for the handicapped in the first case, while not considering it in the second one. In some countries special concern is focused on problems of rural education, ethnic minorities, immigrants, illiterates, and the poor. Other countries do not have these needs, or they are simply unrecognized. Educational expansion and vocational training are important priorities in some societies, while others must adjust to declining enrollments and place their emphasis on academic preparation. All of these differences in educational policy concerns will necessarily be reflected in the debates, discussions, and formation of a school finance agenda.

As this presentation suggests, substantial differences characterize school finance from nation to nation. There is not a single and unified approach to school finance that is suitable for every situation. Although principles of school finance can be applied to many different societies, their actual applications must reflect the unique economic, political, social, and cultural attributes of each setting. In a more general sense, there is no universal tax or expenditure approach that is uniquely suitable to education. The specific revenue needs of the schools and their disbursement patterns must always be based upon a consideration of the overall economic, political, social, and cultural context in which they will be employed.

Before proceeding with a description and analysis of the field of school finance, it is useful to present some patterns of school expenditure. Two statistics are of particular interest: the proportion of gross national product (GNP) that is allocated to education, and the proportion of total public expenditures that is allocated to education. Available sources of data such as those in the UNESCO *Statistical Yearbook* tend to combine expenditure at all levels, including those for higher education, so higher educational expenditures are also included in the following generalizations.

In the decade of the 1970s, about 2–9 percent of GNP was devoted to public educational expenditures among nations. In general, those countries with higher proportions of their young enrolled in school and with higher per capita incomes spent a larger proportion of GNP on education. In a worldwide survey of this phenomenon, Eicher (1982 p. 59) found that for every 1 percent increase in GNP, there was an increase of over 2 percent in public educational expenditure among countries from all major regions of the world in 1960–65. This declined to about a 1.3 percent increase in the 1965–76 period, but educational expenditures still maintained a faster rate of growth than did GNP. Only in North America was there a decline in the proportion of GNP devoted to education in the later 1970s, a phenomenon reflecting especially the decline in youth and school enrollments in the United States.

There are at least two reasons why educational expenditures tend to increase at a faster rate than GNP. First, at relatively low levels of per capita income, most of what is produced must be used for consumption with little surplus available for investments in schooling or other areas. But at higher per capita incomes the available resources for both social and private investment rise. Second, as countries become more industrialized, there is a greater private and social demand for schooling.

According to the UNESCO *Statistical Yearbook* for 1980, about 8–30 percent of all public expenditures among nations was allocated to education in the 1970s, with an average of 13 percent for a sample of industrialized countries, and 15 percent for developing countries in 1977/78 (Lewin et al. 1982). That is, developing countries were devoting a slightly higher portion of their public expenditures to education than industrialized countries, even though their proportionate commitment from GNP was somewhat lower. What is clear is that education makes a prodigious demand on the resources of almost all societies, and even these amounts do not reflect the sizeable private expenditures on schooling and related educational needs such as books, transportation, and uniforms.

1. Decisions in School Finance

The best way to understand the field of school finance is to consider it as a decision-oriented phenomenon in which educational decisions must be translated into ways of financing schools. Each society has its own educational priorities, system of government finance, political mechanisms for making decisions, and administrative structures for implementing them. School finance represents one of the major dimensions of these structures and processes, and such financial decisions must be made concomitantly with broader policy decisions in education and in the larger society. In a sense, each educational decision has implications for ascertaining how resources will be obtained and allocated. By reviewing a number of different decision areas in education, it is possible to see their consequences for school finance.

1.1 How Much Schooling?

In every society the questions must be asked, who will be educated and how much education will be provided? The responses to these questions take the form of both philosophical discussions and as laws and policies regarding a constitutional right to education, ages of compulsory attendance, and provisions for schooling. Depending upon the answers to these questions, particular populations will be eligible to attend school, and a certain portion may be compelled to attend. Further, given the availability of schools, there will be a tendency for participation in noncompulsory schooling (e.g., higher education) to rise over time as more and more persons complete the compulsory years. When these phenomena are combined with the size and growth of the eligible youth populations, provision must be made for adequate numbers of places in elementary and/or secondary schools.

The decision on who will be educated and how much schooling to provide will depend upon a number of factors. It will depend upon a particular society's goals and the role of schooling in achieving those goals as well as the cost of schooling relative to other approaches to meeting those objectives. It will also depend upon the resources available to a society for addressing schooling and other needs. That is, the ultimate decision must be based upon the priorities for schooling relative to its cost in the light of the overall resource constraints faced by a society.

The commitment to an education for specific populations has immediate financial implications. First, it provides a basis for determining the size of enrollments, the most important single determinant of cost and revenue needs. Second, it suggests a basis for planning and establishing schools to meet the commitment and any subsequent increases in enrollments that follow from that commitment. This information is necessary to plan for new schools and the expansion of existing ones. The financial implications arising from who will be educated represent the most fundamental building blocks of a system of school finance. Both the projection of capital costs and operating costs depend upon an understanding of who will be eligible to attend school and who will actually participate.

The ability to ascertain the number of students that should be planned for at each level is essential to designing an adequate system of school finance. A number of analytic tools have been developed for this purpose. The most basic is that of demographic studies of the population which transform birth rates and the size of the youth population at each schooling level into anticipated enrollments at each level for specific target dates in the future (Davis 1980b Part 2). To a large extent, this type of analysis must ascertain not only who is eligible to attend each schooling level, but what proportion will actually attend if schools are available. Social demands for schooling can be developed statistically to make these estimates (Davis 1980a Chap. 3). Such approaches do not take account of the overall priority for the expansion of schooling relative to other priorities or the competing claims on available resources.

In wealthier societies, it may be suitable to let schooling expand as rapidly as the demands for it grow, particularly if there is a belief or evidence that the additional benefits of that schooling exceed the additional costs. But most countries face severe restraints on following this approach, given the dearth of resources and the severe competition for them, and even the richer industrial societies face serious problems of unemployment among their educated populations. Accordingly, some societies may choose to plan the expansion of schooling beyond the compulsory years according to some sense of social or economic need for the nation.

The manpower planning approach attempts to estimate the required number of workers with different levels of schooling according to the occupational needs for meeting specific objectives of economic output at some future target period (Blaug 1970 Chap. 5). The numbers of enrollments at each schooling level are planned to meet these future manpower requirements. There are many problems with this approach including the fact that it does not consider directly the cost of meeting manpower objectives in alternative ways and that it assumes fixed relationships between economic output requirements and occupational needs on the one hand and occupational needs and educational requirements on the other. Such fixed relationships do not seem to be supported by the data (Hollister 1967).

The rate-of-return approach provides a method of assessing the expansion of schooling in terms of an investment where the future increase in economic output from an investment in education is compared with the cost of the additional schooling (Becker 1964, Psacharopoulos 1973). In this way one can compare the returns for social investments in schooling with investments in other public goods such as health or capital investment in plant and equipment. Presumably, further investment in schooling should proceed only when its rate of return exceeds those for alternatives. This technique has been criticized because of its crucial assumption that increases in social productivity of workers can be assessed according to the higher earnings that they receive when they have obtained more schooling (Berry 1980 pp. 187–204). Further, since data on future earnings for educated persons are not available, they are estimated by looking at older workers at each level of education on the assumption that existing workers will experience the same age–earnings patterns. This may also introduce distortions into the estimates (Eckaus 1973). However, all of these analytic tools are considered to be helpful, at least at an heuristic level, in planning for future enrollments, even if they can not be applied mechanically to the issue (Blaug 1970 Chap. 7).

1.2 How Will They Be Educated?

Once having established who will be educated and how much education will be provided, it is necessary to ask what types of education will be provided. There are at least three basic dimensions to this question. First, what type of education will be offered at each level? Of particular concern is the nature of the primary curriculum and the emphasis on vocational versus academic education at the secondary level as well as the specific requirements of each. Second, what quality of education will be offered? Clearly a system of large classes using minimal facilities with modest instructional materials and poorly trained teachers will require fewer resources than one with greater qualitative depth. Third, what provisions will be made for children with special educational needs, such as the physically and mentally handicapped, intellectually gifted, immigrants, and those from poverty backgrounds? It is widely recognized that such groups have particular educational requirements that may necessitate supplementary resources (Kakalik et al. 1981, Levin 1973).

The answers to each of these questions have profound implications for determining the overall resource requirements for school finance. The nature of the primary educational curriculum and the division of secondary students between academic and vocational training have major cost consequences, since each is associated with a different pattern of resource and support needs (Hu and Stromsdorfer 1979). This is obviously true for differences in school quality, with the cost per student increasing as a function of teacher preparation, reduction in class size, and the facilities and instructional materials that are provided. Because of the predominance of teacher costs, the decision on class size alone can dominate cost patterns. Essentially, a reduction in class size by 50 percent will tend to increase the cost per student by almost 100 percent. Finally, the greater the attention to the special needs of particular students, the more resources that will be required to meet educational commitments (Kakalik et al. 1981).

The criteria for making these decisions tend to be based upon both political and social values. However, some analysis can inform these decisions. For example, curriculum decisions can be determined partially by the usefulness of the education in meeting certain societal goals (Foster 1965). To the degree that one of those goals is meeting the needs for integrating workers into appropriate labor markets, it is possible to relate specific schooling experiences to career preparation or to eligibility for higher educational experiences that lead to careers. This does not mean that the economic value of a curriculum is the only criterion that should be employed, since there are important social, political, and individual needs that must be met through the schools. These needs might not always be compatible with those of preparing young people for existing work opportunities.

Likewise, the quality issue must be assessed with respect to the benefits of any particular level of resource utilization in meeting the goals of schooling relative to the costs of those resources. One criterion that has been used on an international basis is that of the contribution of educational factors to cognitive achievement as reflected in test scores (Heyneman and Loxley 1982, Simmons and Alexander 1978). The literature on this subject, that of educational production functions, seeks to determine how changes in different educational inputs such as class size and teacher quality create differences in student achievement (Levin 1976). However, again, it is important to note that the quality of education should not be judged on the basis of test scores alone.

One major implication of the quality dimension for school finance is the impact of this decision on the nature of schooling between public and private sectors. In many societies, the investment in the public schools and the quality of those schools is so low that they are utilized only by families who have no other alternatives. Middle- and upper-income families send their children to private schools which are more highly endowed with educational resources. The result is the existence of a dual system of schools: a low quality public one with large classes, modestly trained teachers, poor materials, and inferior facilities that is attended by children from low-income families, and a higher quality private system with smaller classes and better teachers and other amenities. The latter charges tuition and fees that are beyond the reach of poor families.

Because of the powerful political position of families who can afford to send their children to private schools, state subsidies are often provided to the private schools. In some cases, these subsidies rival or exceed the support for public school pupils. Accordingly, the public school quality decision may have a profound effect on the formation and public support of private schools as well as the creation of a dual school system in which the poor attend the low quality public schools and the more affluent attend the higher quality private schools.

Finally, the question arises as to what type of analysis might inform the provision of supplementary educational resources to those students with special needs. While exactly what should be done educationally for the handicapped, intellectually gifted, immigrants, and the poor is a matter of social and political priorities, there exist analytical approaches that can ascertain the costs of different educational provisions for these groups (Hartman 1981). The overall methodology is that of ascertaining the type of educational programs that attend to their special needs. Using a "resource cost approach," these educational programs can be evaluated in terms of the specific resources that they will require as well as the cost of these supplementary resources. If the costs are greater than can be accommodated by available funding, program modifications can be designed, and new cost estimates can be made until a suitable plan with regard to meeting special needs within cost constraints is established.

1.3 Who Should Pay?

The resources that are required for elementary and secondary schools include those that are used directly to provide instruction and those that must be present in the schooling process. Among the first of these are teachers, buildings, materials, equipment, and so on. These are used to provide instructional programs that are designed to produce particular educational outcomes. Among the second of these are the time and efforts of students to undertake instruction and to study. In many societies the use of student time at the upper-primary level and secondary level represents a cost to families, since students could use that time for productive labor and contribute support to their own families. By allocating their time to schooling activities instead of to productive labor, they are sacrificing earnings. Thus, the time of the student must be considered to be a resource that is usually "paid" for by the family in terms of reduced income, and the total cost of schooling must include this element as well as the direct instructional costs.

Each society must decide who should pay the costs of the resources that are required for schooling. One principle that is used is that of benefits received. That is, the various constituencies should bear the costs of schooling according to the benefits that are received from schooling. For example, schooling is supposed to have considerable benefits for the entire society in the form of a more literate and productive nation with a common language and common set of values (Weisbrod 1964, Bowen 1977). Schooling also provides advantages for the individual students and their families in the form of higher status, earnings, and access to opportunities. The problem of allocating costs between the larger society and the individual participants in the schools is that it is difficult to determine in a precise sense the social and private benefits of schooling. Further, even in the domain of public support for schooling, one must allocate the tax burden fairly among groups with different abilities to support public expenditure.

1.4 What is the Appropriate Governmental Structure?

The appropriate governmental structure for the sponsorship of schools has important implications for school finance. Different societies rely on different principles of school organization. Some societies provide a highly centralized form of school organization and governance in order to maximize the uniformity of school operations. Others are organized largely according to region and locality within certain national laws or guidelines. One based upon regional and local sponsorship provides greater potential for responding to the specific needs of the school populations that are being served. The balance between central and regional or local governance of schools will determine the balance between uniformity and diversity. Such a decision on governance can have profound implications for school finance, since decision-making responsibilities at any governmental level often entail financing responsibilities as well.

To the degree that there is some reliance upon regional and local authorities in the finance of education, issues of school finance inequalities arise. Units of government may differ in the level of educational support for their students according to their relative priorities for education in comparison with other public and private goods. However, an even more important determinant of support for education will be the income or wealth of a region or municipality that must finance its schools and other services (Coons et al. 1970). That is, different regions and localities differ in their income and wealth, and thus in their capacity to support schools for their children. Especially important in this regard are differences between urban and rural areas, where the latter are usually considerably poorer than the former.

When there is great reliance on regional and local units of government to sponsor schools, inequalities in school funding are inevitable. In many cases the central government must take responsibility for providing grants to state and local governments with inadequate resources to provide a minimally acceptable quality of schooling for all eligible youth (Sherman 1980). The state or regional governments may also provide such equalizing grants to individual local schools. In some cases, higher levels of government will also provide categorical grants to their decentralized school authorities to induce them to provide specific categories of educational services such as those for disadvantaged and handicapped children.

A final aspect of governmental structure is the choice between government and private sponsorship of schools. Friedman (1962) has argued that although the government should provide resources for schooling because of its important spillover benefits for the society as a whole, the actual operation of schools should be under private auspices. He argues that such arrangements would compete for students, and a competitive schooling approach is likely to be more efficient than a government monopoly. Most societies have rejected this argument on the basis that a private school system—even though funded by the government—would not provide the transmission of a common set of values and knowledge required for social cohesion, productivity and democracy. However, many nations provide at least some public support to private schools while maintaining a system of government schools as well.

2. Obtaining and Allocating Resources

Educational decisions of a society require the provision of resources for the schools. The specific answers to such questions as how much and what types of education will be provided, who should pay, and what governmental structure will prevail provide the necessary background for considering two major questions in school finance: how will resources be obtained, and how will resources be allocated to different levels of schooling, different types of students, and different regions and localities?

There are two criteria that can be used to analyze each of these issues: efficiency and equity. Efficiency generally refers to using available resources in a way that maximizes the welfare of a society (Levin 1976). Equity generally refers to distributing the benefits and costs of any endeavor in a way that is considered to be fair. It is clear that both concepts are socially determined in that what is assumed to be efficient and equitable in one society might be considered to be inefficient and inequitable in another. However, the two criteria are of great assistance for any particular society in evaluating the most appropriate methods for both obtaining and allocating resources for the schools.

2.1 Obtaining Resources for Schooling

The first issue that arises with respect to obtaining resources for schooling is how the burden of support will be distributed between the government and families. Even when the government pays the direct cost of instruction, families must often pay for the costs of books, uniforms, athletic equipment, and the loss of forgone earnings of their older children who are enrolled in school rather than being employed.

In general, it is argued that primary and most secondary education provides social benefits of such an important nature that the entire society should support them (Friedman 1962 Chap. 6, Weisbrod 1964). These benefits include a common set of values, knowledge, a standard language, skills for modern work enterprise, the development of latent scientific and cultural talent, and many more. It is assumed that these benefits contribute to a productive and democratic society with respect to its economic, political, social, cultural, scientific, and artistic potential and accomplishments. Further, widespread participation in modern societies requires that all individuals be exposed to a set of common experiences that are requisite to obtaining access to available opportunities. This democratization of access to opportunities is considered to be an important social benefit in itself. Because of the perception that elementary and secondary schooling are necessary ingredients for the functioning of modern societies, most nations take the view that the direct costs of providing schooling should be subsidized through public funds.

A central question that arises is what type of tax system is most appropriate for the support of elementary and secondary schools from the perspectives of efficiency and equity. In general, there are two concepts of tax equity that might be considered: benefits received and ability to pay (Musgrave and Musgrave 1976 pp. 210–20). The benefits-received principle assumes that the tax burden ought to be levied according to the benefits received by different constituencies. But, since public elementary and secondary schooling are considered to be justified on the basis of their social benefits for the entire society—benefits that cannot easily be divided into those received by different entities or groups—the benefits-received principle cannot readily be applied.

The ability-to-pay principle assumes that those taxpayers with greater ability to support the tax system—usually those with greater income and wealth—ought to provide larger contributions to tax revenues than those with lesser resources. It also presumes that the payment of a given amount of income in taxes for a rich person entails a lower sacrifice of happiness than the same payment for a poorer person. Ability-to-pay approaches argue that the generation of any particular level of public revenue should exact the minimum sacrifice in social welfare or happiness, and this will generally mean that a richer household will pay more than a poorer one. The actual application of this principle will depend upon the specific tax base and the particular form of the assumptions regarding both how to minimize social sacrifice and how additional income is assumed to contribute to happiness at different income levels (Musgrave and Musgrave 1976 pp. 215–24).

Efficiency in taxation refers to the effects of the tax system on the entire economy as well as minimizing the collection and compliance costs for raising any particular revenues. If one believes that the "natural" workings of a free economy produce the most efficient allocation of resources, then it is important that any system of taxation minimizes the distortions to that system (Musgrave and Musgrave 1976 Chap. 21). Of course, monopoly concentration in many industries and the effects of trade unions and government raise serious questions about the existence of a free and competitive economy. Further, sometimes the tax system is used to provide "desirable" distortions such as taxation on tobacco products, liquor, and luxury goods, which is designed to reduce consumption of those products. However, the design of a tax system should always be scrutinized to minimize any distortions that are considered to be undesirable.

Efficiency in collection and compliance refers to minimizing the costs required to obtain a given level of revenue. In this respect, costs refer not only to the governmental resources that are required to collect the tax, but also the cost to the taxpayer of complying with the demands of the tax system. Different taxes are associated with different costs of collection and compliance.

Thus far we have referred to the characteristics of systems of taxation in general terms rather than with regard to school finance. A system of public revenues for school finance has two other characteristics that are desirable: stability and growth. Stability refers to the yield of a tax system from year to year. An educational system will have predictable revenue needs, and it is important that the tax system provide those needs with high reliability. Some systems of taxation will be characterized by large fluctuations from year to year depending upon economic conditions. For example, a tax on the export of primary commodities will tend to be highly unstable as market conditions vary. Thus, such a tax is likely to be a poor basis for generating relatively stable support for schools from year to year.

To the degree that school enrollments are expanding and quality is improving, it is also desirable that tax revenues grow adequately to meet the rising resource requirements. Some tax bases have greater growth potential than others. Any tax approach should be assessed for whether the tax revenues that it will produce will keep pace with the rising demands upon it for financing schools and other services.

The most widely used taxes are corporate and personal income taxes, sales and consumption taxes, and property taxes. Each is associated with different equity and efficiency consequences, depending upon how it is applied. In general, equity in taxation is determined by ascertaining the incidence of a tax on households in different income classes (Musgrave and Musgrave 1976 Chap. 16). For purposes of defining tax equity, a tax may be characterized as progressive, proportional, or regressive. A progressive tax represents an increasing proportion of household income as income rises; a proportional tax is a constant proportion of income at all income levels; and a regressive tax is one that carries a greater proportional burden on lower incomes than on upper ones.

Since business and property taxes and some sales taxes are not levied on households, it is necessary to know how businesses shift their taxes to households in the form of higher prices, lower earnings for their workers, or lower profits to their owners. In some cases, it is not possible to know in any precise sense how the tax is shifted to these different groups. However, there is a vast literature which has provided broad conclusions on the equity consequences of different taxes (Musgrave and Musgrave 1976 Part 4, Break 1974, Pechman and Okner 1974).

The personal income tax is highly flexible and can be progressive, proportional, or regressive depending upon the structure of tax rates, the definition of taxable income, and provisions for tax deductions, exemptions, and credits. Typically, the statutory tax rates tell little about the actual incidence of the tax. For example, the United States has a highly progressive income tax on the basis of the official tax rates, but the large numbers of tax loopholes that are to the particular advantage of upper income taxpayers mean that the actual incidence is more nearly proportional (Pechman and Okner 1974).

It is difficult to know who ultimately pays the corporate income tax, although a typical assumption is that about one-third of it is paid by consumers in the form of higher prices; one-third is paid by workers and the other factors of production in terms of lower earnings; and one-third is paid by the owners of corporate capital in the form of lower profits (Musgrave and Musgrave 1976 Chap. 18). One type of income tax that is commonly used is the payroll tax. This tax tends to be highly regressive, because it is a tax on the earnings from labor, while not taxing property income. Since property income is concentrated among the highest income groups, a payroll tax does not tax a major source of income for these groups while taxing the major or only income source for lower income households.

Sales taxes can be divided into specific excise taxes and broad-based or general sales taxes (Musgrave and Musgrave 1976 Chap. 20). The former are usually levied on luxury goods or those in which a society wishes to discourage consumption. The latter applies to a much larger set of goods and services. The incidence of the excise tax will obviously depend upon the incomes of families that consume the taxed goods. If the tax is on luxury goods, it will tend to be progressive. A general sales tax can be levied at the point of final purchase or at each stage of manufacture where the tax is applied to the turnover or value added in production. Sales taxes are generally considered to be regressive, because a low income household must allocate a higher proportion of its income to consumption than a richer one. However, the incidence can be made less regressive by excluding such necessities from the tax base as food, basic clothing, shelter, and medical care.

The property tax can be applied to both real property (land and its attachments) and personal property. A tax on real property is particularly attractive at the local level, since local taxes on sales and income may induce rapid shifts in location of households and purchases to avoid the tax. A tax on real property is less subject to such avoidance, especially over the short run. To the degree that the property tax is a tax on shelter it is believed to be regressive, since shelter constitutes a higher proportion of income when income is low. To the degree that the tax is on capital, it may be progressive, since capital ownership is concentrated heavily among high income households (Aaron 1975).

In general, the personal income tax is considered the most efficient with respect to its economic impact in that it does not distort prices of goods and services and market allocations, although very high marginal rates of taxation could reduce the incentive to work or invest. Each of the other taxes does alter the relative prices and returns to different goods and services or sources of income with some effect on the after-tax allocation of resources (Musgrave and Musgrave 1976 Chap. 21).

Collection and compliance costs will differ from country to country. In most nations the collection and compliance costs are lowest for payroll and turnover taxes because the collection mechanism can be made highly routine among the firms providing employment and producing goods and services. Sales taxes and property taxes generally require a more elaborate administrative apparatus for the government. In countries where the income tax has had a long history of acceptance as in the United States, it too will have relatively low costs of collection and compliance relative to its yield. However, in countries where such a tax is not well-accepted, there may be great difficulties in collection.

The design of a system of taxation for school finance, then, must take account of the existing provisions for financing government services in a society. To as great a degree as possible, it must blend goals of equity and efficiency in taxation. Among the factors that must be considered are the incidence and the stability and growth of potential revenues for the tax system as well as its effects on social resource allocation and its costs for collection and compliance.

2.2 *Allocating Resources for Schooling*

In addition to the concern for how resources will be obtained for schooling, decisions must also be made on how to allocate resources to different levels and types of schooling, different types of students, and different regions. These decisions, too, can be analyzed according to the criteria of equity and efficiency where public expenditure is the principal measure of resource distribution. Equity in school expenditures refers to fairness in the distribution of subsidies to students with different educational needs and from different educational and geographical backgrounds. Efficiency in school expenditures refers to using them in the most effective way to meet particular goals such as economic growth or citizen participation.

When defined in this way, equity and efficiency may be complementary to each other, or may be in conflict. As with the case of taxation, each society must determine what is meant by equity in schooling expenditures. For example, if all students are to be given an equal public subsidy for schooling, then it is only necessary to provide equal expenditures for each student, adjusted for differences in the cost of resources from region to region (Chambers 1978). However, equal expenditures will not provide an appropriate or adequate education for each child, if some children need different and more costly resources than others. Children from poverty backgrounds often lack the investments in health, nutrition, and intellectual stimulation that will enable them to succeed in school (Levin 1973). Such students may need compensatory resources such as health services, meals, and remedial assistance in order to benefit from the schooling experience. Of course, this is also a potential efficiency argument in that it is conceivable that much of the standard instruction is wasted on such youngsters unless the additional resources are provided that enable them to take advantage of the regular instruction. A similar case can be made for children from immigrant backgrounds who must develop linguistic competence to be able to benefit fully from instruction in a new language, or handicapped children suffering from impairments that require only the addition of extra resources to benefit from instruction. For example, the provision of sensory aids for those with hearing and sight impairments may be all that is necessary for such children to make normal educational progress. Thus in some cases the arguments for equity and efficiency may reinforce the provision of more educational resources for some groups of children than others.

However, not all cases will be characterized by such a compatible relation between equity and efficiency implications of school expenditure patterns. In some cases, equity will require greater investment in the schooling of a particular group of students without contributing in the most efficient way to other educational goals. In that case, the issue of equity must be viewed as an end in itself, rather than a means to great efficiency. For example, some physical and mental impairments among handicapped children may be so serious that no amount of schooling will prepare the young for productive work or to take care of their own needs. They will always require a high level of custodial care. Yet, providing access to special educational programs that will assist them in caring for many of their needs and developing social skills and relations may be considered to be a high priority, even though it will be a relatively expensive undertaking. In this case, an educational commitment to these populations may be viewed as meritorious, even if it does not contribute to social efficiency in some narrower sense, and a commitment to equity in the use of schooling resources may sacrifice some efficiency in meeting other schooling goals.

In the situation where equity and efficiency considerations are in conflict, a particularly important issue is that of cost. If the costs of the resources required to achieve equity detract only nominally from the achievement of other schooling goals, equity is easier to pursue than if the conflict between the use of resources is substantial. In this case one must examine the trade-offs in using resources from one goal rather than the other. For example, providing education for the handicapped may not contribute to national economic production, but it may contribute to a fairer and more humane society. Both goals are important, and one must weigh the benefits of each against their costs in making appropriate finance decisions (Levin 1975). Although equity and efficiency criteria can be separated for analytical purposes in constructing a system of school finance, only rarely are they separable in practice. In most cases, the conflicts between equity and efficiency considerations are resolved, not by an appeal to economic analysis but by a political process involving various interest groups.

In addition to the equity decisions among different types of students, there is a particular issue that arises when schools are financed at several levels of government. Since regional and local governments will have different capacities to provide schooling based upon their income and wealth, the same tax effort will create rather different amounts of school revenues among governmental entities. In general, urban areas will have more taxable wealth and income, so at the same tax effort they will be able to provide higher expenditures for the schooling of each student. Inequalities in expenditure that emanate from differences in the taxable resources of subunits of government do not have an educational rationale, even though they may reflect accurately the regional distribution of income and wealth. Accordingly, many societies make at least some attempt to more nearly equalize expenditures among regions and municipalities (Oates 1972). In most cases, grants are provided to such governments to compensate for inadequate resources. However, usually there is no attempt to equalize fully the ability to provide schooling of a uniform quality. Rather, the goal is to provide financial assistance to assure at least a minimum level of schooling expenditure for each student, with no attempt to equalize expenditures beyond assuring a minimal level of support.

More recent views of equalization of school expenditures among different governmental units within a country have focused on the concept of fiscal neutrality. Under this approach, the amount of funding spent on each student should be neutral with respect to the fiscal capacity of the unit of government (Feldstein 1975). One method of ensuring a measure of fiscal neutrality is for the central government to assume all responsibility for funding the schools, but such a change also removes much of the source of autonomy and responsiveness of regional and local schools. An alternative method that preserves this autonomy is to permit the decentralized governments to determine their level of tax effort with respect to the tax rate that they choose for supporting the schools. The central government can guarantee that at any level of tax effort the same amount of funding will be available for each child, regardless of the income or wealth of the subunit of government (Coons et al. 1970 Chap. 6). In essence, the central government provides a grant to the regional or local government which represents the difference between what is guaranteed at a particular tax rate and what is raised by the state or local government at that rate.

One of the major efficiency questions in allocating schooling expenditures is that of supporting different levels and types of schooling. For example, what should be the appropriate ratio between expenditures on elementary and secondary schooling? Given an expansion of secondary schooling, what proportion of the additional resources should be placed in vocational versus academic education? One method that has been used to address these issues is to look at each type and level of schooling as an alternative investment in which earnings and employability of graduates represent a major benefit and the costs of instruction and forgone earnings of students during the period of schooling represent the major costs (Psacharopoulos 1973, 1981). In principle, those levels and types of schooling with the highest rate of return on investment will represent the best candidates for expansion. However, such analyses do not account for equity issues or other benefits that are not reflected in employment and earnings.

An example of this problem is raised by the challenge of creating equity and efficiency in regional investment. If economic criteria are used for making educational investment and expenditure decisions, greater investments in schooling would probably be made in the industrialized regions because of the greater employability and productivity of graduates in those areas. To exacerbate the dilemma, the costs of educating a particular student in rural areas are higher because schools and classes must be smaller— given the sparse population densities and lack of mass transportation— and because of the greater difficulties of getting trained teachers into rural areas. However, such a policy would probably contribute to widening gaps among regions in wealth and income, with the better educated persons in rural regions migrating to urban ones.

In the developing societies, these policies have led to massive overcrowding of cities with inadequate infrastructure and services to absorb the immigrants. More nearly equalizing expenditures among regions may reduce the average rate of return on educational investment, since persons in rural areas will be less likely to get appropriate productive employment, and the flow of educated migrants to urban areas will increase. Thus, the dilemma of equity versus efficiency in educational investment is not one that can be resolved easily within the schooling sector itself, although it may be more easily soluble in an overall strategy of rural development.

Thus far, efficiency of educational expenditure has been viewed with respect to its allocation among different types of students, levels of schooling, and geographical areas. However, a different type of concern for efficiency is that of how effective any level of schooling investment will be under different organizational arrangements. Given the massive nature of schooling expenditures in most societies, the question often arises as to whether a given set of educational outcomes could be obtained more efficiently than the present operations of schools can provide. Some analysts have used cost-effectiveness analysis and educational production functions to address these issues (Levin 1976). However, others have argued that the financing mechanism itself should be used to increase efficiency.

The most provocative proposal in this regard is that of Friedman (1962 Chap. 6) to provide a system of educational vouchers to finance elementary and secondary education. Under a voucher system, parents would be given certificates that could be used to pay a specified maximum level of tuition at any school approved by the state. Schools would be sponsored under both public and private auspices to compete for the vouchers. Presumably, the increased competition for students and greater choice would lead to a more responsive and efficient educational system as the market place replaces government decisions on schooling. However, the voucher approach has been criticized as having the potential to destroy the social benefits of schooling by stratifying and inculcating knowledge and values to students according to social class, race, political orientation, and religion (Levin 1980). It is argued that this would undermine social cohesion and the potential for an effectively functioning democracy. In addition, it has been asserted that the administrative arrangements for centralized record keeping and administration of a voucher plan that must account for every school-age child would be extremely costly, offsetting any gains in efficiency from competition.

A more modest approach with somewhat similar consequences is that of tuition tax credits (Catterall and Levin 1982). Under this plan a parent would be able to obtain a reduction in taxes for each child enrolled in a private school. In addition to the problems associated with vouchers, this approach has also been criticized because those families who are so poor that they pay little or no taxes would not be eligible for any benefits.

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3. Summary and Future Issues

School finance is tied intimately to both educational and social commitments of a society as well as the resources for meeting those commitments. There is no overall model that provides the most appropriate approach to financing schools for all situations. Each society will need to consider its own educational and social priorities as well as its means for addressing them. Further, issues of school finance cannot be separated from the overall system of financing government in a society. However, there exist a number of analytic concepts and tools for evaluating different approaches to school finance from the perspectives of both equity and efficiency in the use of social resources.

Perhaps the most important challenge to school finance is presented by the rising costs of schooling at a time when world economic crisis has limited severely the capabilities of most societies to meet concommitantly all of their aspirations (O'Connor 1973). Schooling is a labor-intensive activity, and as the costs of living rise, educational salaries must keep pace. If enrollments increase at the same time that expenditures per student are maintained, the overall cost of schooling must continue to rise.

There exist three ways to constrain such costs: restricting the growth in enrollments; reducing the quality of instruction; and finding ways to maintain or increase quality at lower cost per student. The first of these has severe political and ethical implications, but it may be unavoidable in the long run unless other alternatives emerge. The second seems to be an unwise choice at a time when most countries are concerned that existing quality is too low. The third represents the challenge of our times. Can new technologies such as computers and educational television as well as new organizational arrangements reduce or contain costs, while maintaining or even improving quality? The future agenda of school finance must necessarily be preoccupied with the search for answers to this question.

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Public Finance in Education

J. Wiseman

People wish to acquire education (or parents wish their children to acquire education) because education has a consumption value (those being educated enjoy what is happening to them or, in the case of children, parents predict that their children will lead more satisfactory lives), or because education is expected to enhance the value of the individual concerned in the estimation of employers, and hence the value of the lifetime earnings that the educated person can expect. Thus, education is embarked upon in the expectation that it will confer benefits upon those being educated. The question to be considered is whether they can be left to buy those benefits from their own resources (as they would buy apples or snails), or whether there are reasons for the state to involve itself in the financing arrangements.

1. The Demand for and Supply of Education

It is useful to begin from the following question: why does the government need to involve itself in the provision of education, beyond the general involvement that it has in all market relationships, such as the specification of contractual rights, property laws, and so on? Why not leave it to the market place, like the provision of snails?

There are three arguments which demand examination, suggesting the need for government involvement in the provision or the financing of education. These concern the imperfection of the market in which education is "traded", the imperfections of the information available to those making the relevant decisions, and the possible divergence between the benefits to individuals from spending on education and the benefits to society. An examination of these issues facilitates an informed comparison of the ways in which finance for education might be provided.

The most significant market imperfection concerns the characteristics of the human capital created by the acquisition of education. If the purpose of acquiring education is to enhance future earning capacity, we can think of the individual using resources (his or her own time, teachers, laboratories, and so on) in the present, with the purpose of enhancing the expected value of his or her subsequent earnings. The phrase "investment in human capital" points up the similarity between the use of resources to create physical capital (machines, etc.) which contribute to future production, and the use of resources to enhance human skills and capacities to the same end. But there is an important difference. If I acquire "property" in a machine (e.g., by buying it), I can, if I choose, sell it again. Equally, since the good is transferable, I can use it as security for a loan. That is the way most people buy their houses. If I default, the good can be sold to repay the loan. But if I invest in myself, by increasing my value in the labour market through the acquisition of education, other people can buy the value of the services I provide, but they cannot buy the human capital that makes the provision of those services possible. There is no market in degree certificates. This has led some to argue that human capital is a metaphysical concept, intrinsically different from other kinds of capital. At the other extreme, it can be argued that the difference is not intrinsic, but self-imposed. If people were free to enter into contracts of indenture (under which one person sells property in his or her services to another for a period of years), then property rights in human capital could be the subject of binding contracts. The concept is not unreal: the market in football players in the United Kingdom was until recently something like an indenture market.

However, the rules of most societies set their face against slavery and indenture. In its absence, individuals without financial capital may find it difficult to finance investment in their education, since the lender has no way to obtain adequate security for his or her loan. We have then a first reason for state intervention in the financing of education: the need to correct imperfections in the financial capital market.

A second reason for intervention, whether by financial or other means, relates to the availability of information. At least up to university level, educational decisions are family decisions, though of course the wishes of children are not irrelevant. But, insofar as the decision is an investment one (intended to enhance lifetime earnings) it will have a pay-off period of around 40 years. Clearly, many families are simply not equipped to take efficient decisions of this kind. This is not to argue that others will take such decisions better—the family has other kinds of information not available to outsiders—but only that there may be a case for providing subsidized information relevant to educational decisions. Information is not a free good, and lack of it is no general argument for subsidy. But education has two special and relevant characteristics: much of the information will be collected for other purposes anyway, and there is a broader interest in the improvement of the human capital stock, which would be damaged if children failed to achieve their educational potential for lack of relevant information.

Finally, state intervention (finance) may be called for because education confers benefits to society at large greater than those captured by the educated individual. In its simplest form, this is the proposition that A, by acquiring human capital through education, not only enhances his or her own expected earnings, but also those of B. Consequently, if A finances his or her own educational investment without subsidy, and is concerned only with the benefits expected to accrue to himself or herself, less education will be acquired than is in the interest of the community. The ideal solution to such a problem would be to find a means to make B pay for what he or she gets: a subsidy to A's education is clearly less satisfactory, since there is no reason to suppose that the necessary taxes will be levied on those who benefit. In any case, convincing evidence that the benefits of human investment are not captured by the investors is not easy to come by: it is a statement of faith supported by anecdote, rather than a well-documented phenomenon. This is not to deny that human (educational) investment may make countries richer—though the relationship is not a simple one—but only to question whether some of the yield on the human investment accrues to noninvestors.

This form of the social benefit argument is sometimes broadened to embrace a much wider notion of social values: the educated (and/or the education system) confer "benefit" by improving society, by the promotion of social cohesion, or whatever. As an argument for state financing of education, this needs to be treated with the most profound suspicion. For it leads to the public support of those kinds of education that support the values thought to be desirable by those providing the funds. There is no lack of examples of state-supported education being used to inculcate values that not everyone would share: the education system of Nazi Germany is a sufficient example. If public subsidy is to be related to such arguments, then the constitutional and political rights of individuals and families become central to the decision about qualification for subsidy.

2. *The Finance of Education and the Rights of Parents and Students*

Following the argument developed above, the methods of financing education can be classified by beginning from a simple specification of objective, and asking how financing can be arranged to contribute to its attainment. The conclusions can then be modified to incorporate different or additional objectives.

The defined objective is the fulfilment of parental choices about the education of children, or, at the more senior level, the fulfilment of the choices of the (university or adult) students themselves, though family involvement is not ruled out: parents contribute to the higher education of students in many countries, and in some (such as the United Kingdom), state financial support is actually provided on the assumption that they will do so.

It has already been established that simply to leave educational provision to the forces of the market may prove inefficient, though it is worth noting that it does not follow logically that the state need become involved in either finance or provision. There are many cases, for example, of private "caring" behaviour (church schools, scholarships, and so on) emerging to fill the gap between family resources and the educational potential of children: it is not an accident that educational institutions commonly have charitable status. But such voluntary behaviour may not be thought to be enough.

For the younger age group, the two reasons for state action concern the imperfections of the capital market, and the belief that there is a social benefit from education not captured by the student. The first of these would suggest loans to parents as the appropriate remedy but there are two difficulties. First, the education is of primary benefit to the child, who cannot enter into a legally binding contract to repay. Second, the child can have only a limited influence over the educational choices made by the parents. If these problems are compounded by those related to social benefit, then some form of subsidization becomes more appropriate.

(But note that there is nothing in the argument that requires the state actually to *provide* the education.)

The form of subsidy consistent with the argument so far is the education voucher. Various forms of voucher have been proposed. Their common characteristic is that they provide parents with a voucher for each child "cashable" at the school of their choice. To attract pupils, schools would need to adapt to the demands of parents, and good schools (and teachers), as evaluated by parents, would grow in size while others would decline. The education voucher arouses strong emotions, and arguments for and against of varying degrees of sophistication. The argument that parents are not fit to make such choices is simply authoritarian; it is referred to again below. Equally, the argument that the system would be unstable because parents would move children around implies a dim view of the sophistication of both headteachers and parents. It is likely that special schools would emerge (ethnic, Marxist, high ability, etc.), but if that is what parents want, one could argue that it is acceptable or even desirable.

There have been experiments with vouchers, specifically in the United States. The results are not easy to evaluate, as with all such social experiments: the scheme was embedded in the existing school system, no new buildings could be built, teachers lost no security of tenure, and so on. What did emerge was that parents and children did have educational preferences, that these did not follow the lines usually assumed by educators (of segregation by ability), and, summarily, that the voucher did offer the possibility of an education system responsive to parental and student preferences. Voucher finance is compatible with a variety of views about the need to relate the benefits of state support to the needs of the poor. If it is regarded as part of the system of state income redistribution, for example, the voucher can be treated as taxable income.

At the more senior level, the same two problems emerge, but can be resolved directly by a system of student loans. Again, there are a variety of possibilities. The general intention is to remedy the deficiency in the capital market by the state providing the loan, or, less commonly, the security for a private loan. Insofar as the social benefit argument is accepted, the loan may be at privilege interest rates, or some part of the costs of university education may be subsidized. The argument for loans is of course one of equity: why correct a market imperfection by a method (a subsidy) that redistributes income towards those who, on the basis of past evidence, are going to become the richer members of the community because of both their ability and their investment in human (educational) capital?

On the other side, it is argued first that some students, and particularly those of poor parents, would be deterred from further education by the need to borrow. The empirical evidence does not support this view. Second, it is argued that students interested in occupations of high social value but relatively low reward would be penalized. Third, it is argued that the loans would constitute a "negative dowry" for intelligent women, as their husbands would have to repay their loans. A properly designed loan scheme can deal with all these problems. Rather than the fixed-interest repayment schemes which now exist, loan recovery should be a percentage of subsequent taxable income, with relief for wives with children still in full-time education. This takes care of both the incentive problems and the difficulties of default that some fixed-interest schemes now experience.

3. *The Political Economy of Education Finance*

Readers can be forgiven for deciding, at this stage, that this entry is not about how education *is* financed, but about how it *might be* financed. The criticism would be justified: everywhere, governments are heavily involved in funding education, and without much apparent reference to the arguments so far developed. However, students and families do seem to appreciate the problem: some work for separate schools where ethnic needs would be recognized, they use family investment (the African nuclear family) to provide the resources for graduate study abroad, and so on.

Opposition to the kind of intellectual construct so far developed rests on rejection of the right of parents to exercise uninhibited choice about the education of their children ("it is the duty of the state to protect children against their parents"), and/or on the assertion that access to educational facilities is not a matter of economics but a right of citizenship. Such views lead to the position that all children should have the same rights, and that one such right is to free (i.e., state-financed) education. In its more extreme manifestations, it leads to such further propositions as that all children should go to the same kinds of schools, that ability streaming is wrong, and that the private provision of education for fees should be illegal.

Thus, the apparently technical question of how to finance education becomes a sophisticated issue concerned with social values and with the respective rights of parents, children, teachers, and governments. It is, at present, a strange confrontation. In most countries, governments, central or local, are the major financial providers, but their claim that the establishment (government and/or teachers) knows best is increasingly under challenge. To say that parents should not make educational choices will not stop them trying, particularly when they believe fundamental principles to be involved (as with religious education). Nor is the claim that teachers (and hence local and/or central government) have special expertise and hence know best a particularly credible one.

The major problem is the practical one of how change might occur. There are strong property rights and vested interests in the financing of education through the public sector. History and logic suggest that this situation can be changed, if people so wish, only gradually.

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Financing Vocational and Industrial Education

M. Woodhall

Vocational and industrial education and training takes many forms. In the past, the bulk of all vocational and industrial education was provided on the job by employers for their own workers. The costs of this education and training were shared between the employers, who provided personnel, equipment, and other facilities, and the trainees, who accepted low wages during the period of training. For many workers the period of vocational education and training was long and it consisted largely of observation and imitation of a skilled worker, either as part of a formal apprenticeship, or through an informal period of training. However, as the skill requirements of the jobs became more complex, the need for more formal types of vocational education and training was widely accepted. Vocational schools were established, and new types of combined on-the-job and off-the-job training were created. The questions of the means of finance, the relative contributions of employers, workers, and government funds, the distribution of costs and benefits of vocational education and industrial training, and the policy and institutional implications of alternative financing mechanisms have attracted increasing attention. Throughout the world governments have become increasingly involved in the provision and financing of vocational education and training, both because of its importance for economic and manpower policy and because of increasing concern about the need to share the costs and benefits of education and training equitably.

Studies of the financing of vocational education and training have been concerned with such issues as:

(a) The overall level of resources devoted to vocational education and training; and the adequacy of resources for sufficient quantity and quality of training to meet personnel needs.

(b) The distribution of resources between general and vocational education, between different types and levels of education, between general training and training for specific jobs, between different groups of workers, and between on-the-job and off-the-job training.

(c) The distribution of the costs and benefits of vocational education and training and the profitability of training as an investment for employers, for individual workers, and for the community as a whole.

(d) The role of the government and the reasons for government intervention. Should it take the form of legislative action and regulation of training, or should it take the form of financial intervention, through taxation and payment of subsidies to employers or individual workers, or should the government be involved in the actual provision of vocational education and training?

(e) The effectiveness and implications of different financial mechanisms, for example payroll taxes, training levies, and the payment of selective subsidies for training. What are the economic and educational consequences of different methods of financing vocational education and industrial training?

In some cases, also, there have been extensive studies of particular types or methods of vocational education and training, including apprenticeship and the provision of retraining opportunities for unemployed workers, or paid educational leave for employees.

Economists have also been much concerned with the question of whether the distinction between general and vocational education is valid. Since general education also prepares students or pupils for employment, the distinction between general and vocational education may be misleading, and one writer goes so far as to call the emphasis on vocational education in some developing countries the "vocational school fallacy in development planning" (Foster 1965). Much of this debate is not particularly concerned with the financing of education and training; however, the question of how the financing of education should be shared between the government, employers, and workers is sometimes linked with arguments about the distinction between general and vocational education even though, as Blaug argues, much confusion is created by:

> . . . the conventional distinction between academic and vocational education. This distinction, which is actually grounded in the nature of the two curricula, is allowed to carry the implication that some education prepares students for the world of work and some does not. All too frequently, however, those who have taken courses of study generally called "academic" . . . reap substantial financial returns from their education, thus producing the paradoxical conclusion that academic education has a greater "vocational" value than vocational education. The traditional distinction was developed by educators but the labour market has its own way of appraising qualifications. (Blaug 1972 p. 247)

Controversies about the distinction between general and vocational education, and similarly controversies about the distinction between education and training fall outside the scope of this article, although they may impinge upon debates about how education should be financed.

1. Resources Devoted to Vocational Education and Training

It is difficult to estimate the total costs of vocational education and industrial training, since employers do not necessarily keep accurate records of the time or expenditure devoted to on-the-job training, and it is difficult to estimate the contribution of individual trainees, since this would require estimates of the value of their productive work and the distribution of their time between learning and producing. An early study of the costs of industrial training in the United States by Mincer estimated that the total opportunity cost of vocational training, including informal "learning by doing" as well as formal training programmes was over US$16 billion in 1958, about US$10 billion of this represented the cost of training in private firms or corporate enterprises, and approximately 70 percent of this was the result of informal on-the-job training and only 30 percent was attributable to formal training programmes (Mincer 1962).

However, there are many practical and conceptual difficulties involved in estimating the total costs of vocational education and industrial training. Data from enterprises is often nonexistent or inaccurate, and it is difficult to find estimates of the value of the productive work of trainees; for example, one study of the costs of training in the engineering industry in the United Kingdom produced estimates of the value of the output of trainees which ranged from zero to 60 percent of the output of a skilled worker in a trainee's second year of training, and 25 to 85 percent in the third year. To estimate the opportunity cost of training would require such estimates of the productive value of trainees' work, in order to compare this with the actual earnings of trainees. As a result of the difficulties of such an exercise, there have been few attempts to measure the resources devoted to vocational education and training, although very rough estimates suggest that the total costs of industrial training may be as much as a third or a half of total expenditure on education. Estimates of the costs of vocational education and training in the United Kingdom suggest that in 1970 this amounted to roughly half the total expenditure on full-time formal education (Woodhall 1977), and a recent review of training in the United Kingdom concluded: "The cost of education is about £9,000 million per annum (in Great Britain). It is hard to put a boundary around vocational training activities but a rough estimate would put the cost at about £3,000 million a year" (Johnson 1979 p. 1093).

Nevertheless, there is a feeling in many countries that not enough resources have been invested in vocational education and training, particularly during periods of recession. The result of such underinvestment in training may be a shortage of skilled workers when there is an increase in economic activity. It is in order to stimulate investment in vocational education and training, and to avoid such shortages, that governments in many countries have become increasingly involved in the financing or provision of vocational education. In some cases, governments have simply provided a legislative or regulatory framework for the redistribution of the costs of training, for example by means of a levy–grant system. In other cases governments have provided direct subsidies to encourage investment in vocational education and training.

2. The Role of Government in the Financing of Vocational Education and Training

Traditionally, the finance and the provision of vocational education and training has been the responsibility of employers who, in some cases, have passed on to trainees the direct costs of training. It has been assumed that employers will invest in training if it is profitable in terms of increased productivity of workers, or necessary, in order to achieve desired levels of output and efficiency. In such cases, there is no obvious need for government activity. Regulations governing safety or standards of training have, in many cases, been the sole form of government involvement. However, in recent decades government involvement has increased, partly in order to link vocational education and training more closely to general economic and employment policies, partly because of a growing concern with questions about the distribution of training opportunities or with underinvestment in training, from the point of view of the economy as a whole.

In many countries, the role of government has widened, in order to increase the supply of training opportunities, either as a part of general economic or manpower policy, or as a countercyclical measure, or as a part of regional policy. In some countries governments have tried to improve the transition from school to working life by developing closer links between formal education and industrial training, or by improving the quality of vocational education and training. In other cases, government involvement has developed because of a concern about the distribution of the costs and benefits of vocational education and training.

For example, in the United Kingdom the Industrial Training Act was passed in 1964 with the threefold aim of increasing the amount of training in industry, improving its quality, and redistributing the costs of training more fairly between firms, by means of a levy–grant system. The Act created 30 industrial-training boards, whose function was to stimulate training activity and reallocate the costs of training by imposing a compulsory levy on firms, in proportion to their total expenditure on wages and salaries, and distributing a series of training grants to firms which provided training. The purpose of the levy–grant system was to redistribute the costs of training by ensuring that all firms contributed towards the costs of training regardless of whether they actually provided training. The levies imposed by the industrial-training boards ranged from under one percent to over three percent of total wages and salaries, and in addition to the operation of the levy–grant system, industrial-training boards provided advice and guidance to firms on industrial training and set quality standards. There is evidence that this system of "sticks and carrots", designed to stimulate and regulate training, did increase the quantity of training provided in the United Kingdom. However, the industrial-training boards and the Industrial Training Act were subject to considerable criticism (Woodhall 1974).

The compulsory levy–grant system of the Industrial Training Act was replaced in 1974 by a selective levy–grant system involving exemptions for small firms, or firms judged by the industrial-training boards to be providing adequate training for their own labour needs. This meant that the levies were no longer compulsory, but were imposed on firms which provided no training for their own employees, or provided only very limited training, or training judged to be of poor quality. In other words, the levies were more in the nature of a "fine" imposed on firms for underinvesting in training, than a "tax" which could be used to help finance training.

Another example of a selective levy–grant system was proposed in the Federal Republic of Germany by the Edding Commission on the costs and financing of vocational training, which reported in 1974. As a result of these proposals, a new law was passed in 1976, the law on the promotion of new training places (*Ausbildungsplatzforderungsgesetz*), which allowed a levy–grant system to be created if the supply of training places in industry was insufficient for the future needs of the economy. Thus, the policy was based on the principle that industry should be responsible for recruiting and training sufficient personnel, and that government intervention would be justified only if there was a shortage of training opportunities. However, this scheme has now been withdrawn.

In many countries, however, there has been a debate about whether more permanent government intervention is needed, and in some cases legislation has been introduced to provide a permanent mechanism for redistributing the costs of training or for increasing investment in vocational education and training. In France, for example, there is a compulsory system of training funds and an apprenticeship tax, so that all firms must pay a proportion of their total wages and salaries as a payroll tax, and these funds are used to finance vocational education and training. In Sweden employers must pay a special employment tax which is used to finance vocational education for adults.

In other countries the government provides subsidies to encourage training, and the costs of these are met out of general taxation. For example, in Australia, the Commonwealth Rebate for Apprenticeship Full-time Training (CRAFT) is a subsidy which is intended to reimburse employers for part of the costs of apprenticeship training.

In some other countries, however, the government role is wider and includes the provision of vocational education and training in public institutions, rather than subsidies towards the cost of training provided by employers. In Canada, for example, the bulk of the training financed under the Canada Manpower Training Program is provided in public institutions, such as community colleges or vocational education centres, but in some cases the government may finance training which is provided on employers' premises.

In many countries initial vocational education is provided in schools and other public institutions and this is financed in exactly the same way as general education, by means of national or local taxation. In the Federal Republic of Germany a dual system of vocational education has developed, with vocational education taking place partly in vocational schools, which are financed out of public funds, and partly by means of on-the-job training, provided and financed by employers. The training provided by employers is subject to various government regulations, under the Vocational Education Act of 1969, and all young trainees under the age of 18 are obliged to attend a vocational school on a part-time basis, in addition to receiving on-the-job training. Thus, in the Federal Republic of Germany the responsibility for providing and financing vocational education and training is shared between government and employers. Austria, too, has developed a dual system of vocational education. In other countries it is only a minority of young workers who are enrolled in formal apprenticeship programmes whose training is jointly financed in this way.

In some countries there have been debates about the desirability or need for a permanent system of collective funding for vocational education and training, with the costs being shared between government and employers. In the United Kingdom proposals were put forward in 1976 for a system of collective funding which would be jointly financed by employers and government, and would have as its main objective "the achievement of a high and stable intake into training for skills of vital importance to the economy" (United Kingdom Department of Employment 1976 p. 16). The main argument for a system of collective funding was that training in transferable skills, that is, skills which are needed in more than one specific job, benefits the whole economy, and not just one employer. Therefore the costs of training should be shared between employers and the community as a whole. However, the proposals for a system of collective funding for transferable skills which were put forward in the United Kingdom in 1976 did not gain acceptance at that time, although the government, through the Manpower Services Commission, has become increasingly involved in the financing of training for key skills, that is, skills which are regarded as vitally important for the economy and are likely to be in short supply. Training grants, financed out of public funds, have been provided to encourage employers to take on additional trainees.

In many countries some system of subsidies or grants is provided by the government to stimulate training by employers, and this has been increasing in recent years. Another area of increasing government involvement is the finance and provision of vocational education and training for the unemployed. Partly as a result of the worldwide recession of the 1970s and early 1980s and the growing problem of unemployment particularly among young people, and partly because of a growing awareness of the economic importance of vocational education and training, there has been a general trend towards increased government involvement in both the finance and the provision of training, and a gradual shift in many countries in the balance of resources contributed by government, employers, and trainees.

The question of how the costs of training should be shared between government, employers, and individuals raises the question of who benefits from expenditure on training. Vocational education and training, like other forms of education and training, is an investment in human capital which brings benefits in the form of enhanced productivity, and higher levels of output and earnings. These benefits are enjoyed by the individual, by his or her employer, and by the community at large. However, the way in which the costs and benefits of education and training are distributed between the individual, the employer, and the taxpayer raises many issues and depends, partly, on the nature of the training, and particularly on whether it is general or specific.

3. *General and Specific Training*

One of the earliest attempts to analyse expenditure on education and training as a form of investment in human capital was by the United States economist, Gary Becker, who drew the distinction between general and specific training. Becker (1964) argued that the costs of general training, which increases the potential productivity of a worker in a wide range of jobs, in many different enterprises, will be borne mainly by the worker, in the form of lower wages, that is to say, forgone earnings, during the period of training. Specific training, on the other hand, increases the worker's productivity only in one job or a narrow range of jobs in a single firm or enterprise. Therefore the employer will be willing to bear the costs of specific training, in the expectation of the benefits, in the form of higher levels of future output (Becker 1964). In practice, of course, it is seldom possible to differentiate completely between general and specific training; it will depend not only on the content of the training but on mobility of labour and other conditions in the labour market, and trade-union bargaining will influence the distribution of costs between employers and employees. Moreover, Becker's analysis was concerned with on-the-job training whereas much vocational education and training takes place off the job, as well as on the job, and the question of how this is financed raises even more questions. Nevertheless, the distinction between general and specific training is an important one, and it is likely to determine, at least in part, the extent to which employers are willing to finance vocational training.

The increasing involvement of governments in the finance and provision of training in many countries is on the grounds that much of the vocational education and training provided for new entrants to the labour market, or for unemployed workers, is general training which will benefit the whole community and in this context the term "training for transferable skills" is often used. It is argued that while employers will be willing to finance specific training, or training for their own immediate needs, there is a need for governments to help finance training for wider needs. For example a discussion document produced by the United Kingdom government distinguishes between five different types, or levels, of training:

(a) training arranged by particular employers to meet their own immediate or forseeable needs;

(b) training going beyond the obvious needs of particular employers but necessary to meet the forseeable needs of an industry as a whole;

(c) training given to individuals to meet national economic needs, going beyond the obvious needs of particular industries;

(d) training given to individuals to enable them to take new—or better—jobs which they cannot get without first acquiring new skills; and

(e) the contribution of education.

Different methods of finance are appropriate for these five different types of vocational education and training. The first, in most countries, is the responsibility of the employers who finance and provide the training themselves. The second may require a sharing of financial responsibility between different firms or enterprises within an industry, for example, through the levy–grant system operated by the industrial-training boards in the United Kingdom. However, for the other types of training listed, there is likely to be an increasing proportion of the costs of training which are met by central, state, or local government, on the grounds that the training benefits the whole community.

In the case of training given to individuals to enable them to take new jobs, this may be financed directly by the government, which provides free training places in public institutions, or it may be financed indirectly by means of training allowances to individuals, to enable them to meet the costs of vocational training, as part of the general policy on student aid. However, even if individuals are given grants or loans to help them to finance vocational education and training, some part of the opportunity cost will fall on the individual in the form of forgone earnings, although the opportunity cost of training for the unemployed may be very low.

4. *The Choice between On-the-job and Off-the-job Training*

The precise way in which the costs of different types of vocational education and training should be shared between individuals, employers, and government is still a matter of controversy in many countries, together with the question of how much training is general and how much is specific, and how much should be provided on the job and how much in vocational schools or other institutions.

A study for the World Bank reviewed the literature on these questions, including 54 studies of industrial training in both developed and developing countries and concluded:

> The survey of the literature raised more questions than it answered and uncovered no universally applicable solution to the problem of whether vocational school or on-the-job training is more effective. . . . It is impossible to determine the cost effectiveness of any method on the basis of these studies, and there is no conclusive evidence that one type of training is superior to others. (Zymelman 1976 pp. 5–6)

The same could be said for the question of the relative superiority of different methods of financing vocational education and training. No universally applicable solution is available to the problem of how the costs of training should be met. Zymelman suggests that the choice between on-the-job and off-the-job training will depend not only on cost, but on general economic and institutional factors, and he lists such factors as the rate of unemployment, level of wages, the entry requirements for jobs, the attitude of firms and trade unions, the quality and availability of instructors, as well as the average and marginal costs of training, labour market conditions (including the degree of competition between firms), and finally the administrative machinery for allocating public resources by means of subsidies or tax incentives. All these factors will also determine the method of financing training.

Zymelman (1976) emphasizes that the choice between on-the-job and off-the-job training is not a simple one: "the array of training methods can be arranged along a continuum, with off-the-job training at one extreme and on-the-job at the other" (p. 11). He concludes that "the choice of a mode of training will depend not on any pat answers but on the careful assessment of all relevant influences . . . only with an overview of both economic and noneconomic considerations can the decision maker arrive at a judicious selection" (p. 39).

5. *The Balance Between Public and Private Financing of Vocational and Industrial Education*

Similarly, questions of the balance between public and private finance and provision of vocational education and training depend on both economic, political, and institutional factors. In many countries the proportion of public funds being devoted to vocational training as part of manpower and employment policies or countercyclical measures designed to influence the overall level of demand in the economy, has increased since the early 1970s. At the same time there have been various developments in national policies towards vocational education which are designed to improve the transition from school to work. These include the introduction of work experience for pupils in upper-secondary school; teaching about the world of work, known as *arbeitslehre* in the Federal Republic of Germany, where it plays an important part in the vocational preparation of young people in secondary schools; and various new approaches and innovations in combining practical experience and theoretical instruction, for example preapprenticeship courses in Australia and France, or the introduction of a "basic year" for apprentices in the Federal Republic of Germany and Denmark, or the development of career education in the United States. All these innovations are designed to improve the transition from school to work, to improve the vocational preparation of young people, and to help to minimize unemployment among young people. One effect of all these measures, however, is to shift the balance of financing of vocational and industrial education and training away from employers, including private firms and enterprises, and towards public financing and provision. In some cases this is an unintended result of educational and manpower policies, while in other countries it reflects conscious economic planning decisions.

6. *Apprenticeship*

One way of combining practical experience with theoretical vocational education which is important in many countries is apprenticeship. This is a formal contract between an employer and a trainee, or apprentice; under the terms of this contract the trainee undertakes to work for the employer for a specified period and the employer undertakes to provide practical experience and instruction which will allow the apprentice to attain the status of a skilled craftsman. In the past it was common practice in some occupations, and in some countries, for the apprentice to pay the employer, or "master" for instruction but the common practice now is for apprentices to be paid a wage while they are training, which is lower than that of a skilled craftsman, but gradually increases during the period of the apprenticeship, until it reaches the level of a skilled worker's wage. Thus, the traditional way of financing apprenticeship training involved a sharing of the costs between employers and trainees (in the form of reduced wages).

However, in recent years, there have been increasing criticisms of traditional apprenticeship training in many countries, and gradual changes both in the methods of education and training and in the methods of finance.

For example a report in Canada in 1973 concluded: "The available evidence strongly suggests that complete reliance on the traditional wage mechanism to finance on-the-job instruction for apprentices is no longer practical" (quoted in Organisation for Economic Co-operation and Development 1979 p. 56). The changes that have taken place involve a shift towards collective funding of apprenticeship training, with the government playing an increasing role. These changes have been reviewed by the Organisation for Economic Co-operation and Development (OECD) in an analysis of policies for apprenticeship (Organisation for Economic Co-operation and Development 1979). Mechanisms for collective funding of apprenticeship include the pooling of voluntary contributions from employers and trade unions in a training fund, as in the United States; a compulsory apprenticeship tax, as in France; the provision of tax incentives or subsidies for employers providing apprenticeship training, as in Australia; subsidies in the form of additional training allowances for apprentices with very low wages, as in the Federal Republic of Germany where a means-tested training allowance known as *berufsausbildungsbeihilfe* exists; and various subsidies such as family allowances or tax deductions for parents of apprentices, such as exist in Austria, Denmark, and some other European countries.

The proportion of young workers receiving apprenticeship training, compared with other forms of vocational education or general education varies considerably between countries. Table 1, which is derived from the OECD report on apprenticeship policies, shows that the proportion of school pupils aged 15 to 18 entering apprenticeship programmes varied from 55 and 53 percent in Austria and Switzerland in 1975 and 1976 to about 2 percent in Finland and the United States. The OECD report concludes: "All efforts to reform the apprenticeship system have found it extremely difficult to solve the questions of financing and cost sharing. . . . The pressure on governments to devise collective financing measures such as already exist in several countries is considerable" (OECD 1979 p. 80).

7. *Paid Educational Leave*

Another recent development which has changed the pattern of financing vocational and industrial education in some countries is the provision of paid educational leave for employees (described as educational leave of absence in some countries), which means that employers continue to pay wages to employees while they receive part-time or full-time vocational or general education. The possibility of paid educational leave or educational leave of absence has existed in some occupations, and in some countries, for many years but it is only in recent years that legislative changes have made the provision of paid educational leave a matter of right for workers in some countries. In 1973 the International Labour Organization (ILO) adopted the recommendation that "the principle of paid educational leave should be regarded as a new labour right". However, the extent to which workers do have the right to paid educational leave varies considerably among countries. Some European countries, for example France and Sweden, have introduced legislation giving workers this right. In some countries trade-union negotiations have won this right for many workers, for example in Italy. In other coun-

Table 1
Activities of young people on leaving compulsory school in selected OECD countries: Percentage of school leavers in each activity[a]

Country	Year 1	Full-time general education 2	Vocational education 3	Apprenticeship 4	Work or unemployment 5	Others and unknown 6	Total 7
Austria[c]	1976	14.8	24.3	53.5	7.4		100
Federal Republic of Germany[b]	1976	47.8		46.2	2.7	3.3	100
Switzerland[c]	1975	17.0		55.0	28.0		100
Austria[c]	1975	24.0		15.0	61.0		100
England and Wales[c]	1974	20.8		17.8	51.1	10.4	100
Finland[c]	1975	—	77.7	2.1	—	—	100
France[c]	1975	33.3	31.2	12.5	23.0		100
Ireland[d]	1975	26.0		10.0	59.0	5.0	100
Denmark[d]	1973	65.0	3.0	15.0	15.0	2.0	100
Netherlands[c]	1968/69	75.0		3.0	18.0	4.0	100
United States[e]	1972	51.5	8.0	2.4	28.0[f]	10.0	100

Notes
a Source: Organisation for Economic Co-operation and Development 1979 p. 27 b Plans of school leavers aged 15–19 (mostly 15–16). Includes *Gymnasia* leavers of which there were 133,314 out of a total of 888,949 leavers c Age 15–16 or completion of compulsory school d Age 16, completion of school beyond compulsory e Plans of seniors in high school, mostly 17–18 years old f Includes other vocational training

tries paid educational leave is very rare, or is confined to a few privileged occupations.

Similarly, there are considerable variations in the methods of financing paid educational leave. The conclusions of a study by OECD in 1976 is that "the system that has been adopted, whereby employers are expected to bear the brunt of the financial effort, gives rise to many ambiguous situations which are a source of conflict". But the report also notes "The type of financing adopted, whereby employers are required to make a considerable effort, gives no clue as to who finally bears the financial burden of the system. Virtually all countries have . . . tended to make the financing of educational leave the responsibility of the community (via tax-payers and/or consumers) or to require a limited contribution from the workers" (OECD 1976 p. 40).

In other words, paid educational leave, like other financial mechanisms described above, is simply one way of distributing the costs of vocational education and training between employers, workers, and taxpayers. The best way of sharing these costs remains a controversial issue in many countries.

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Student Loans

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Students in higher education in many developed and less developed countries (LDCs) receive financial aid in the form of loans, which must be repaid after the students graduate or complete their education. Student loans, together with scholarships, grants, bursaries, or fellowships represent one of the main ways in which governments or private institutions provide financial support for students, to enable them to pay tuition fees or living expenses. However loans, unlike other forms of student support, must ultimately be repaid. There are a wide variety of student loan schemes operating in different countries, and the conditions under which the loan schemes are administrated differ substantially.

Student loans are the subject of considerable controversy in several countries, because there is disagreement about whether students should be subsidized by means of loans or grants and scholarships. There is disagreement about the effects of loans and disagreement about the best way of providing financial aid for students. Advocates and opponents of loans argue in the fiercest manner, often ignoring the actual experience of various countries with student loan schemes. However, there is a considerable body of experience, since student loans have been widely used as a means of supporting students in higher education since at least the early 1960s. This section will therefore describe the type of student loan schemes operating in various countries in Europe and North and South America, consider the arguments for and against loans, and review the evidence on the effects of student loans as a means of financing higher education.

The arguments about student loans concern the effect of loans compared with other forms of financial aid on enrolment rates, particularly among poor students from low-income families, the equity of different methods of financing students, the effects of loans on student motivation and performance, and the costs of administering loan programmes and administrative problems, such as which institutions should provide the loan, how to organize repayment, what rate of interest should be charged, how to deal with students who default on repayment, and so on.

1. *Different Types of Financial Aid for Students*

Governments throughout the world provide financial support for students in higher education. The extent of subsidization of education and the way in which subsidies are provided differ substantially in different countries but in every country, both developed and less developed, governments provide a large part of the financial resources for higher education, as well as for